MECHANICAL ENGINEERING

• OCTOBER 1952 •

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This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-109-1

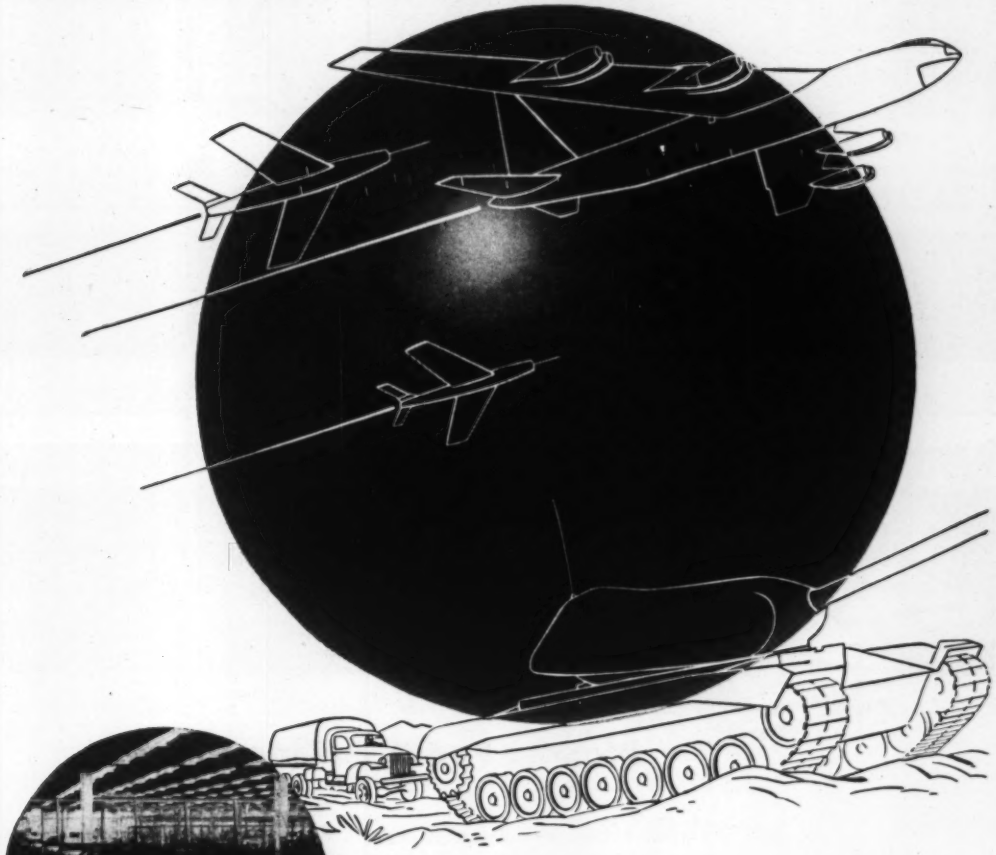
BAILEY METERS

BAILEY METER COMPANY

1026 IVANHOE ROAD
CLEVELAND 10, OHIO

Control

SILENT SOLDIER FOR DEFENSE!



Factory, Farm and Fighting Front...

• On the Korean front, on farms deep in the heart of America, in factories geared to the needs of defense . . . New Departure Ball Bearings are worthy warriors.

• Back of the implements of War and Peace stand the machines that produce them. Designers and builders rely on New Departure to simplify production problems. For instance, Sealed-for-Life bearings, originated by New Departure, eliminate separate seals and lubricating fixtures.

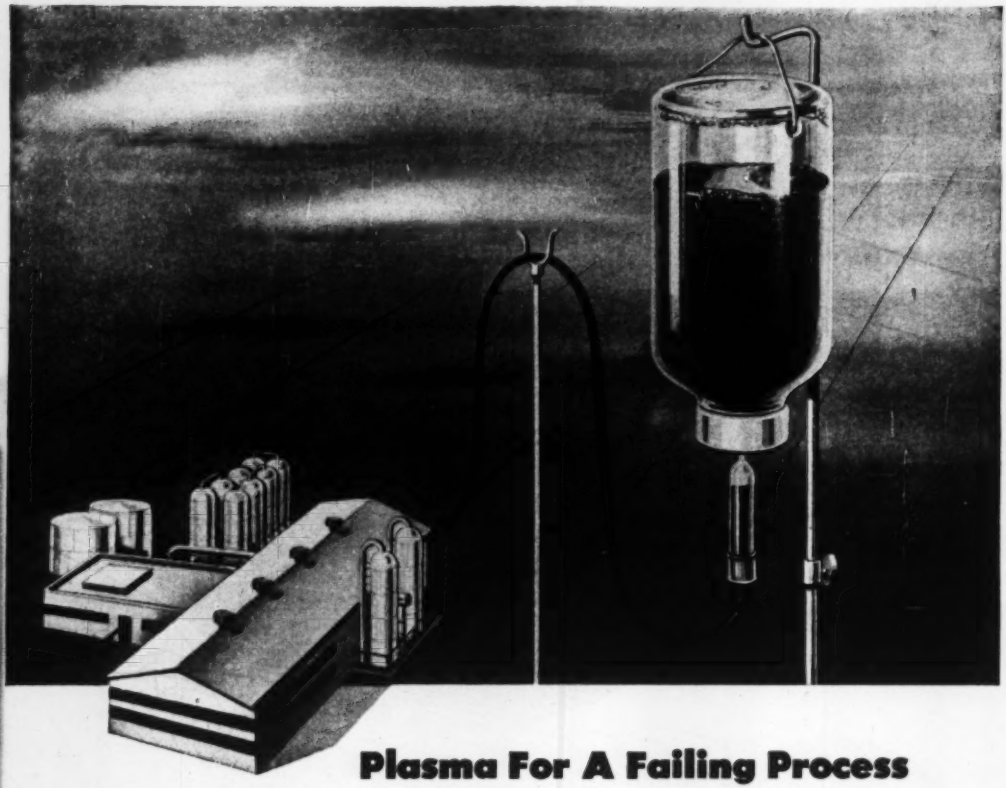
• The Great Ball of New Departure is the symbol of engineering excellence. A staff of application engineers stands ready to aid machine tool designers and builders. Keep your eye on the BALL to be sure of your BEARINGS!

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

MECHANICAL ENGINEERING, October, 1952, Vol. 74, No. 10. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢, to nonmembers on year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.



Plasma For A Failing Process

Throughput usually suffers when any part of your process gets too weak to keep up with the rest of your system. Here's how one company we know prevented such a problem.

Chlorinated hydrocarbons for use in plastics had to be weighed. Test-tube accuracy without metallic pick-up, contamination or discoloration was essential. Stability had to be maintained with sub-zero temperatures.

The answer: jacketed weigh tanks on suspended scales. Passage between shells gave ample circulation for coolant, while a nickel-clad steel inner shell assured purity, gave fast, uniform heat transfer. Easy low-cost maintenance and long life also resulted.

Where did this solution come from? It was the result of cooperative development between the engineering staffs of progressive Equipment Builders, process engineers and materials suppliers. In developing such equipment, these *better* builders regularly turn to Lukens for its knowledge of materials, as well as its wide range of low-cost clad steels.

Even with new equipment hard to get, these builders can often recondition what you have for better, more profitable production. For their names, write us today, explaining your problem. Manager, Marketing Service, 402 Lukens Building, Coatesville, Pennsylvania.

LUKENS

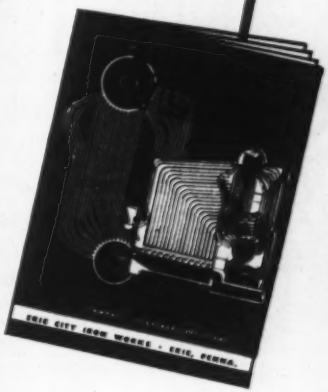
LUKENS STEEL COMPANY

WORLD'S LEADING PRODUCER OF SPECIALTY STEEL PLATE • PLATE SHAPES • HEADS • CLAD STEELS

the Erie City "VC"

A 2-DRUM Steam Generator with complete furnace cooling

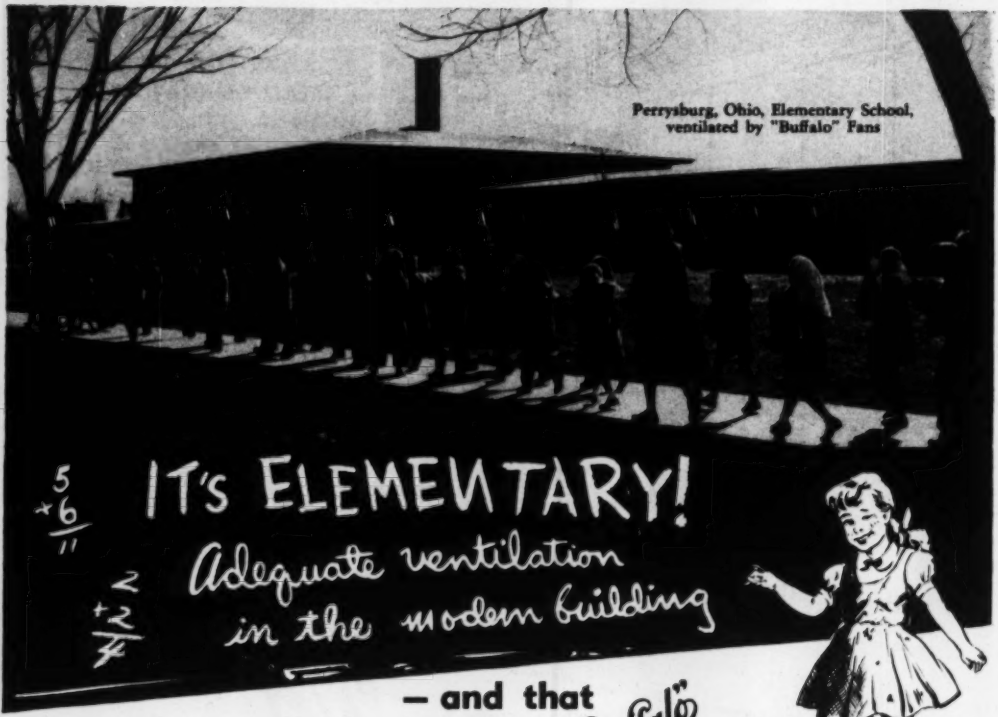
A 50 year experience with 2-drum boilers is reflected in this modern design. Today's ERIE CITY "VC" incorporates scores of design, manufacturing and installation improvements. The Erie City "VC", as described in our latest catalog, offers high capacity in a compact design which saves space — lowers installation and maintenance costs and assures good operating characteristics with a wide choice of fuels and firing methods. New Catalog VC-3 describes the Erie City modern 2-drum Steam Generator in detail.



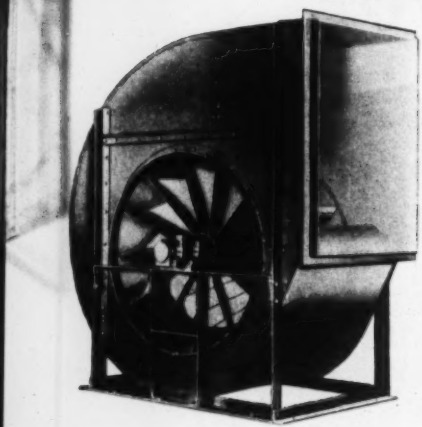
You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



— and that means dependable "Buffalo" FANS



Children in the Perrysburg, Ohio, Elementary School are indeed fortunate. Nothing has been overlooked to give them the finest educational environment—a completely modern building with all facilities, including ventilation by four "Buffalo" Limit-Load Fans like the one shown at left. These quiet, high-efficiency fans are widely recommended for the big air moving jobs in air conditioning and ventilating.

Whether you're concerned with building young minds and bodies, or machine parts, adequate ventilation will help you get better results. Leading educators, industrialists, businessmen in all fields have found this out. And thousands of them have found that you can always rely on "Buffalo" to solve your air moving problem to complete satisfaction. Why not write us about your job for air—we'll give you the right answer, with engineering facts to back it up!

•

Perrysburg, Ohio, Elementary School. Architects: Britsch & Munger, Toledo. Heating & Ventilating Engineers: Mr. P. J. Boes and the late S. D. Bryce, Toledo. Heating Contractors: F. C. Biebesheimer & Sons, Toledo.

"Buffalo" FIRST FOR FANS

BUFFALO "Buffalo" FORGE COMPANY

148 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

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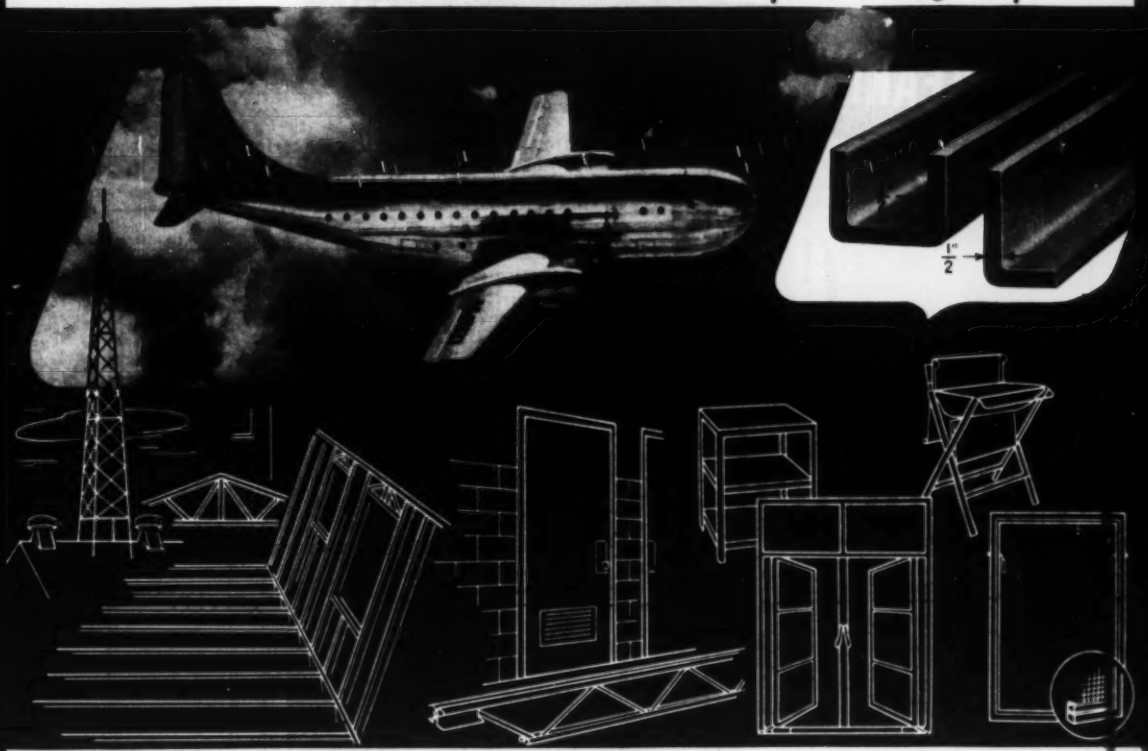
for Greater Strength and Lighter Weight



COLD-ROLL-FORMED *Structurals*

FROM COILED STRIP, you can cold-roll-form plain angles, channels and Z's up to ½" thick. Or you can design shapes to fit your own special needs, at a great gain in strength, or saving in weight, or both. This saving often amounts to more than the entire conversion cost.

Illustrating the high strength-weight ratio of roll formed shapes is their universal use in airplane construction. A few other applications are steel towers for various purposes; framing members for light buildings; partition studs and joists; window frames and sash; doors and trim; metal furniture and fixtures, etc.

Output of a Yoder Cold Roll Forming Machine, with one operator and a helper, is normally at the rate of 4000 to 6000 feet per hour, making the conversion cost a small fraction of a cent per foot. The machine, therefore, may be profitable even if operated only a few days per month. Other operations such as coiling, curving, notching, etc., can be combined with roll forming.

Tell us about your needs in light structurals and we shall be glad to submit recommendations and estimates, without cost or obligation. Illustrated Hand Book on Cold Roll Forming on request.

THE YODER COMPANY • 5499 Walworth Ave., Cleveland 2, Ohio

Complete Production Lines

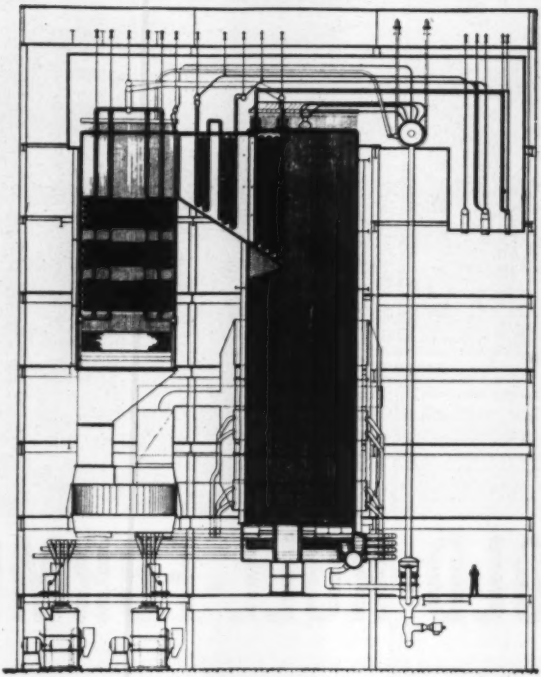
- ★ **COLD-ROLL-FORMING and auxiliary machinery**
- ★ **GANG SLITTING LINES for Coils and Sheets**
- ★ **PIPE and TUBE MILLS—cold forming and welding**

ENGINEERING YODER MANUFACTURING

KEARNY GENERATING STATION

Public Service Electric and Gas Company

C-E controlled circulation boilers



The C-E Unit shown above is one of two duplicate units presently under construction at the Kearny Generating Station of the Public Service Electric and Gas Company at Kearny, New Jersey. Construction work for the new capacity is being performed by United Engineers & Constructors Inc.

Each of these units is designed to serve a 145,000 kw turbine-generator operating at a throttle pressure of 2350 psi with a primary steam temperature of 1100 F, reheated to 1050 F.

These units are of the controlled-circulation, radiant type with a reheater section located between the primary and secondary superheater surfaces. An economizer section follows the rear superheater section and regenerative type air heaters follow the economizer surface.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners. Arrangements are made to use oil and/or natural gas as alternate fuels.

C-E

COMBUSTION ENGINEERING—SUPERHEATER, INC.

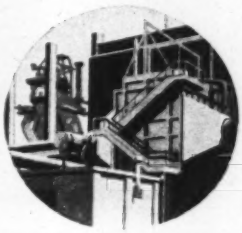
200 Madison Avenue, New York 16, N. Y.

8-589

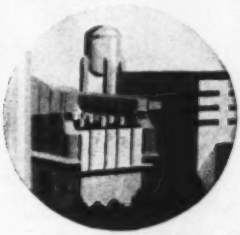
ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

War on waste!

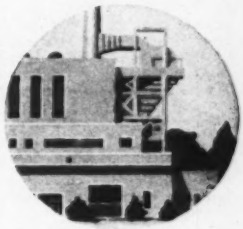
American industry is continually searching for new ways to stop waste and increase production and efficiency. A good example of this is the Koppers-Elex electrostatic precipitator. Shown below are a few typical ways industry uses them to combat waste . . .



BLAST FURNACE GAS must be cleaned before it can be used as a fuel. Koppers-Elex electrostatic precipitators clean this gas to residuals as low as .002 grain per cubic foot.



FLUE GASES from recovery boilers in pulp mills contain valuable materials. Koppers-Elex electrostatic precipitators recover several hundred thousand dollars worth of these materials yearly.



FLY ASH from power plants and factories may drop a blanket of dust extending three to five miles. Koppers-Elex electrostatic precipitators stop this nuisance and preserve public good will.

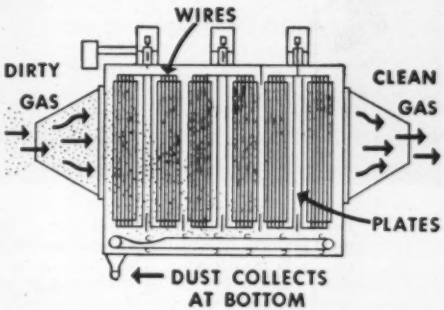
Guaranteed: All Koppers-Elex electrostatic precipitators are guaranteed to equal or better (under tests made by your own personnel) any efficiency or residual content you specify.

ENGINEERS! You should know about these six design features of Koppers-Elex electrostatic precipitators!

KOPPERS has made sweeping improvements in electrostatic precipitator design! For example, double chambers eliminate expensive by-pass systems and the resultant loss of materials during inspection or maintenance. And re-entrainment is sharply reduced because rapping is sectionalized.

Successive collection zones are separately energized to provide maximum voltage for highest collection. And because each field is, in effect, a separate precipitator, the outage of one field *does not stop* gas-cleaning action. In addition, completely enclosed and compact "package" mechanical or vacuum tube power packs simplify installation and operation.

Another exclusive Koppers feature is the drag scraper which provides continuous dust removal, eliminates plugged hoppers and prevents bothersome dust build-up. For detailed information on recovery, gas-cleaning or nuisance abatement results write today to: Koppers Company, Inc., Precipitator Dept., 320 Scott Street, Baltimore 3, Md.



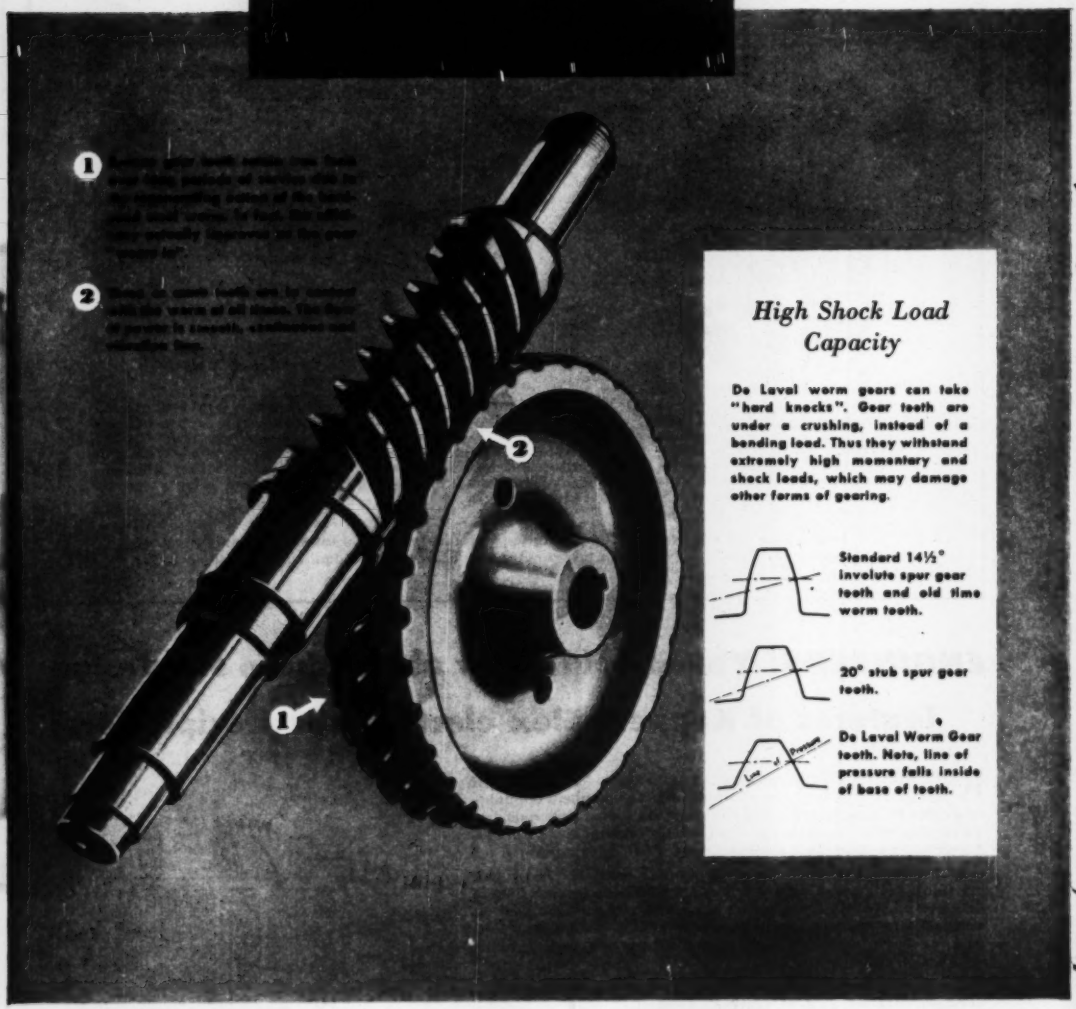
If you have a gas-cleaning problem, write today to: Koppers Company, Inc., Precipitator Dept., 320 Scott St., Baltimore 3, Md.

KOPPERS®

Koppers-Elex ELECTROSTATIC PRECIPITATORS

DE LAVAL

precision-



High Shock Load Capacity

De Laval worm gears can take "hard knocks". Gear tooth are under a crushing, instead of a bending load. Thus they withstand extremely high momentary and shock loads, which may damage other forms of gearing.

Standard 14½° involute spur gear tooth and old time worm tooth.

20° stub spur gear tooth.

De Laval Worm Gear tooth. Note, line of pressure falls inside of base of tooth.

For high productivity, the machine of the future must perform dependably, without breakdowns, with minimum maintenance. The design features shown above explain why De Laval heavy-duty worm gear speed reducers take punishment year-in, year-out . . . seldom require attention even under the most rugged operating conditions. They make a close-coupled, compact drive. High ratio reduction permits use of efficient, high-speed motors and turbines for driving many types of industrial machinery. De Laval builds all sizes, too . . . from 3″ to 30″ center distances for every type of application. Whatever you manufacture—if you use speed reducers—remember that De Laval Speed Reducers are . . . BUILT TO BE BUILT-INTO A QUALITY PRODUCT.

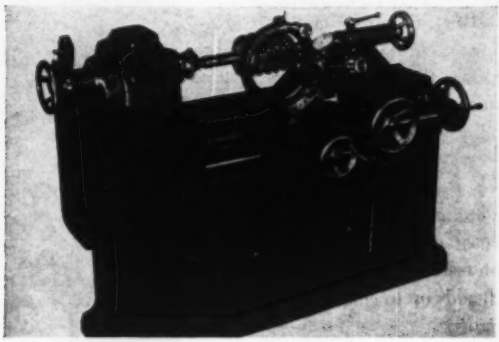
FREE Easy Selection Manuals

New De Laval Manuals G-WBV and G-WWH place at your fingertips valuable data on single and double reduction units. They contain complete selection data, hp rating tables and outline drawings . . . all set up in easy-to-use form. Write for your copies.

made for the machine of the future

HEAT TREATMENT INCREASES WORM LIFE! Carefully selected alloy steel for worms is surface-hardened and heat-treated in controlled atmosphere, forced convection electric furnaces under modern metallurgical inspection and control. This heat treatment provides hard thread surfaces and most desirable core properties.

PRECISION GRINDING ASSURES ACCURATE THREADS! The most modern thread grinding machines available leave nothing to chance at De Laval. To obtain perfect contact between worm and gear, threads of worm are ground to correct lead and contour, using the master worm as a reference. Thousands of installations have proved these quality standards.



HOBS AND WORMS ARE PRECISION-CHECKED! The profile of the worm thread is compared directly with the master worm on this specially designed machine. This insures smooth, quiet, efficient operation. Use of De Laval master worms results in uniformity, correct thread thickness, precise tooth contour and interchangeability of parts.

GEARS ARE HOBBED BY TANGENTIAL FEED PROCESS! In De Laval gears, the teeth are generated in bronze gear blanks by the tangential feed process, recognized as the most satisfactory method of producing worm gears. Hobs are designed and manufactured by De Laval to secure close control of quality, dimension and form.

DE LAVAL *Speed Reducers*

DE LAVAL STEAM TURBINE COMPANY
806 Nottingham Way, Trenton 2, New Jersey

DL1M

3 ways B-L can help you with a castable lining for catalytic equipment

1 Engineering

Today, the same high-caliber engineering that pioneered the use of suspended linings for refinery furnaces is available to you for castable linings, too. This new B-L innovation is designed to give you a serviceable, yet economical enclosure for catalytic equipment—vessels, lines, cyclones, stacks and ducts.

2 Materials

Two proven A.P. Green Fire Brick Company materials—SK-7 and KS-4—combine to provide an enclosure adaptable to abrasion, corrosion or heat problems. Various thicknesses of these factory-mixed insulating cements are "gunned" over meshes to form a smooth monolithic wall.

3 Erection Help

It all adds up to a single co-ordinated source for the three elements of a vessel lining or heat enclosure job. In addition to high-level engineering and job-tested materials, B-L is prepared to offer erection service. It all adds up to *one complete package—one contract and one responsibility.*

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"One Source", a new B-L catalog, is yours upon request. No obligation, of course.

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Unit-Suspended Walls & Arches

BIGELOW LIPTAK Corporation

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PHILADELPHIA GEARS
meet your "Specs"

Production headaches?
Not with Phillie Gears.
Regardless of quantity, Phillie Gears
are precision cut, properly heat-
treated and finished to insure
complete interchangeability.

Our Sales and Engineering departments
are staffed with experienced Gear Engineers
who welcome your gear design problems.

Two modern plants, with the finest equipment
can produce your gears *exactly* the way you want them.

Philadelphia Gears

For complete gear information write for a copy of our Gear Catalog.

Philadelphia Gear Works, INC.

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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

A Lot of Dependability in a Small Package

Thousands of industrial firms recognize the Cuno AUTO-KLEAN disc-type strainer as an indication of *protection* on lube and hydraulic systems.

They know the machine builder has provided the best means of keeping fluids *clean* . . . when he has installed the AUTO-KLEAN as standard equipment.

They appreciate, too, the ease with which the AUTO-KLEAN works. A turn of a handle—periodically by hand or continuously by automatic means—is all that is necessary to keep the strainer *itself* clean. This is done without stopping flow. And there's nothing to replace or renew.

They also know that the AUTO-KLEAN is *guaranteed* to remove 100% of the solids larger than specified*. . . with minimum pressure drop.

The Favorite of Designers

The Cuno AUTO-KLEAN solves other problems *right on the board.*

It's compact. A single unit handling full flow (from a few to more than 4000 gpm) occupies no more space than the usual partial-flow type.

You can build it in—or mount it externally. Inlet and outlet can be in any position. You can install it on low pressure or gravity feed or suction with no loss of efficiency.

And you can depend upon it lasting as long as the equipment on which it is installed because it is all-metal and non-collapsible and can be made of a wide range of materials for various fluids, viscosities, temperatures and solids to be handled.

*Available spacings from .0035 in. to .062 in.

Cuno Engineering Corporation
Dept. 651 A, South Vine St., Meriden, Conn.

Please send information on Cuno AUTO-KLEAN

for .....

Name.....

Company.....

Address.....

City.....Zone....State....

Please attach to business letterhead

You Can Clean This Fluid Strainer Without Stopping the Flow

Cuno AUTO-KLEAN is the *only* fluid strainer with "comb-action cleaning" which permits it to work uninterruptedly. Dirt accumulations are dislodged *while* the straining goes on. This can be done automatically. *Guaranteed* to remove 100% of all solids larger than specified.

CUNO

Fluid Conditioning

Removes More Sizes of Solids from More Kinds of Fluids

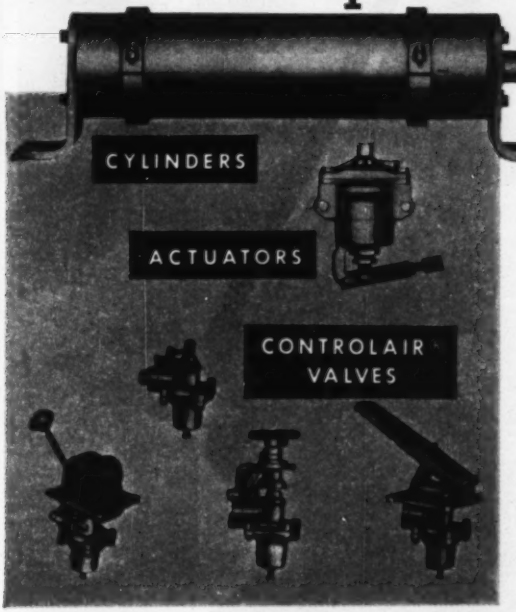
Strain fuels, lubricants, process fluids, etc.—AUTO-KLEAN
Filter fuels, lubricants, process fluids, etc.—MICRO-KLEAN
Clean raw water, recirculating water, etc.—FLO-KLEAN

want to clamp something

...or position it?

use these

low cost pneumatic muscles



It's hard to find a machine that doesn't require powerful, linear motion in some part of its operation. Clutches must be engaged, objects must be grasped and held fast, heavy loads have to be moved in a straight line.

Air is the answer. Pneumatic cylinders exert powerful, cushioned force for any holding operation. Pneumatic actuators allow hair-splitting accuracy if you want to position something exactly. In addition, you have your choice between a very wide range of air controls that permit the most complex interconnected assemblies.

But the best part is this: you can buy everything, the cylinders, actuators, control valves *and* the compressor from one company, Westinghouse Air Brake Company, world leader in engineered pneumatic control systems.

There's a Westinghouse Air Brake Company distributor near you; just look in your Classified Directory under "Air Compressors." He'll be glad to show you how Westinghouse components can help you engineer a better product.

Factory Branch: Emeryville, Calif.
In Canada: Canadian Westinghouse Co., Ltd., Hamilton, Ontario

INDUSTRIAL PRODUCTS DIVISION

WESTINGHOUSE AIR BRAKE COMPANY WILMERDING, PENNA.

How to maintain quality standards in today's expanding production

Johansson

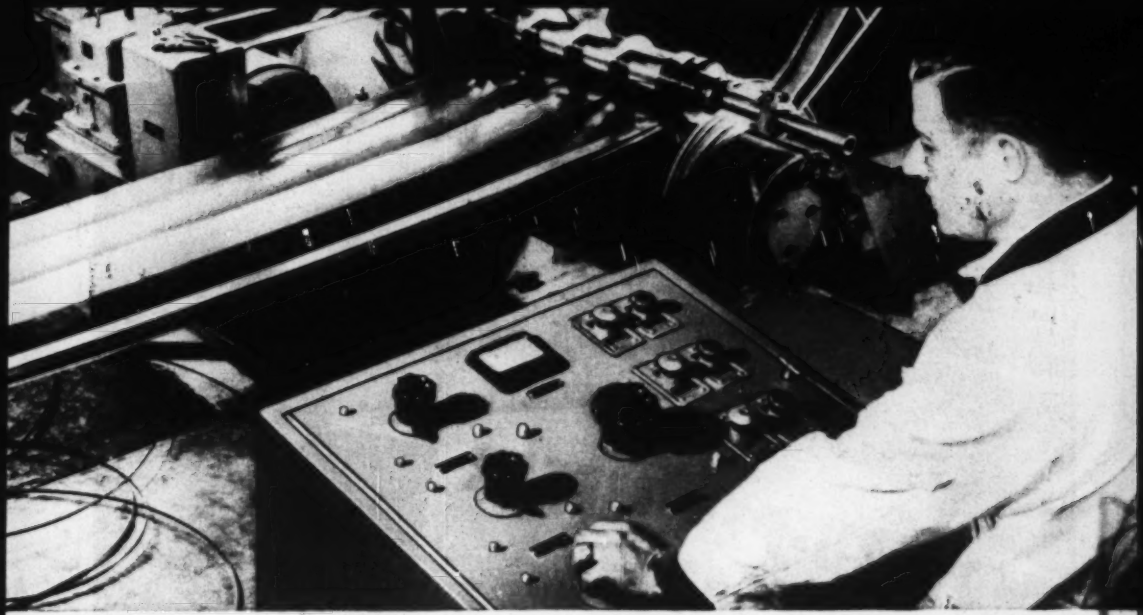
GAGE BLOCKS

In precise measurements — as laboratory standards, or for regular checking of tools and gages — you can insure exacting accuracy and guard against costly rejects by equipping each department with Johansson Gage Blocks. Even with today's need to expand production, you can maintain established quality standards by adding Jo-Block protection whenever you add new men or machines.

Jo-Blocks are made in 3 guaranteed accuracy standards: ±.000002", .000004", and .000008" per inch. Many accessories extend their usefulness. Write for catalog. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

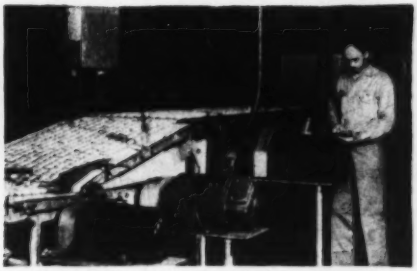
We urge buying through the Distributor

Brown & Sharpe B·S



G-E SPEED VARIATORS, operated by central control panel (above) were chosen by E. F. Hauserman Co. of Cleveland, Ohio for its steel slitting operation. General Electric Speed Variators provide flexible performance in the 1–200-hp range at moderate cost. For even greater accuracy and versatility in automatic operation, these drives may include amplidyne or electronic regulators.

These G-E Adjustable-speed Drives can help you boost your output, too!



G-E THY-MO-TROL* drives assure the Keebler Weyl Baking Co. of Philadelphia of proper baking for many different products. This electronic control is particularly suited for precise adjustable speed in 1/4 to 10-hp drives—offers speed ranges to 100:1 and more.

◀**G-E ACA MOTORS** give the Ford Motor Company a simple, compact, and lowest-cost method of controlling pump speeds at its oxygen generating plant, leased from Air Products Inc. This adjustable-speed motor requires no conversion equipment—an a-c induction motor with stepless speed adjustment by a simple twist of a dial.

*Reg. trade-mark of General Electric Co.

WHICH G-E DRIVES ARE BEST FOR YOU?

Because only General Electric makes *all major types* of electric adjustable-speed drives, it is best qualified to help you select the *right drive*. Send for these informative bulletins.

☐ **A** This 26-page manual describes *all four types* of drives and where to apply them. Bulletin GEA-5334.

☐ **B** Lower cost, simplest a-c drive Bulletin GEA-4883.

☐ **C** More flexibility, moderate cost. Bulletin GEA-5335.

☐ **D** Top performance, ¼-10 hp Bulletin GEA-5337.

☐ **E** Top performance, 1-200 hp Bulletin GEA-5336.

General Electric Company,
Section E 646-19
Schenectady 5, N. Y.

Please send me the bulletins checked

☐ for reference only
☐ for planning an immediate project

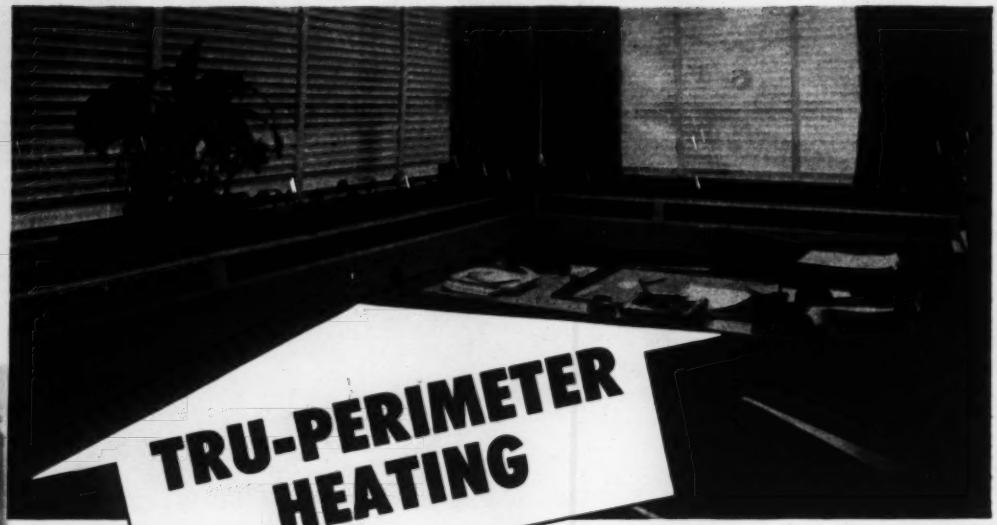
NAME .....

COMPANY .....

ADDRESS .....

CITY ..... **STATE** .....

GENERAL ELECTRIC



TRU-PERIMETER HEATING

Fully air-conditioned Physicians and Surgeons Building, Columbus, Ohio, uses Webster Walvector in perimeter heating to compensate for heat loss from large glass exposure

Webster Walvector, installed under the continuous windows and extending only about 3 inches from the wall, spreads the heat from wall to wall in the Physicians and Surgeons Building. A continuous flow of hot water is circulated, heated sufficiently to completely offset the effect of the cold glass, thereby assuring comfort *everywhere*.

Top heating efficiency is assured through the use of sturdy aluminum fins on copper tubing, spaced for maximum effectiveness. Enclosures with integral grilles are sturdily built of amply heavy steel. Heating elements and enclosures are both mounted on a heavy gauge mounting angle, sealed against the wall with a continuous sponge rubber seal preventing any air flow in back of the mounting or enclosure.

The list of advantages of Webster Perimeter Heating with Webster Walvector is a long one.

Complete technical data on Webster Walvector is available in Bulletin B-1551 and the experience of the 60-year old Webster organization is yours to call upon. Get in touch with your Webster Representative or write us.

Physicians and Surgeons Building, Columbus, Ohio. Completed 1951, features Webster Walvector and complete air-conditioning. Architect: Tibbals, Crumley and Musson. Consulting Engineer: Robert S. Curl and Associates. Heating Contractor: The Huffman Wolfe Company.

Address Dept. ME-10

WARREN WEBSTER & COMPANY

Camden 5, N. J. Representatives in Principal U. S. Cities

In Canada, Darling Brothers, Limited, Montreal

Webster WALVECTOR

REG. U. S. PAT. OFF.

For Steam or Hot Water Heating

WALLACE BARNES COMPANY
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BRISTOL CONNECTICUT
PLANT
ANN ARBOR MICHIGAN
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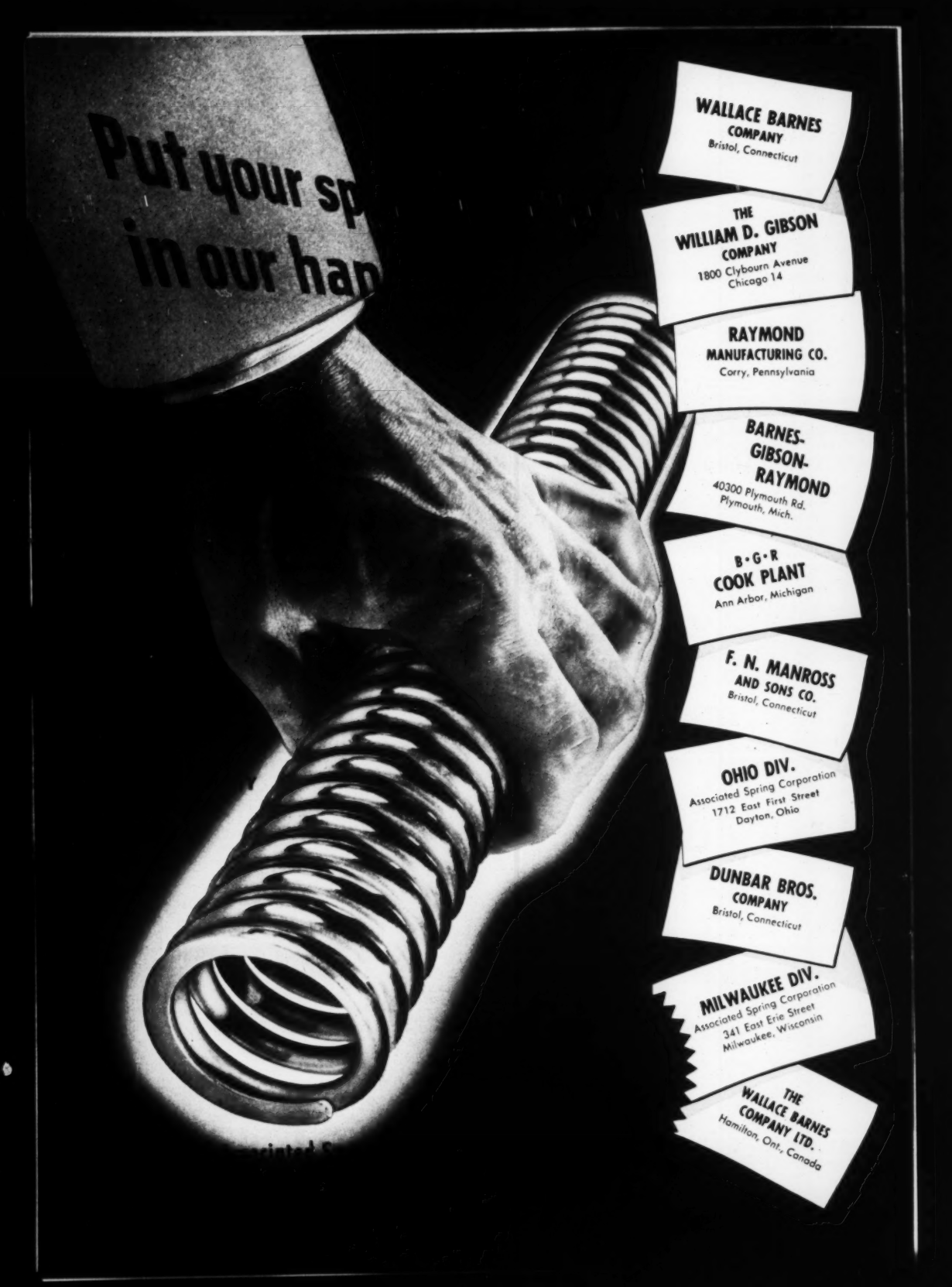
DIVISIONS OF ASSOCIATED SPRING CORPORATION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WALLACE BARNES
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COMPANY
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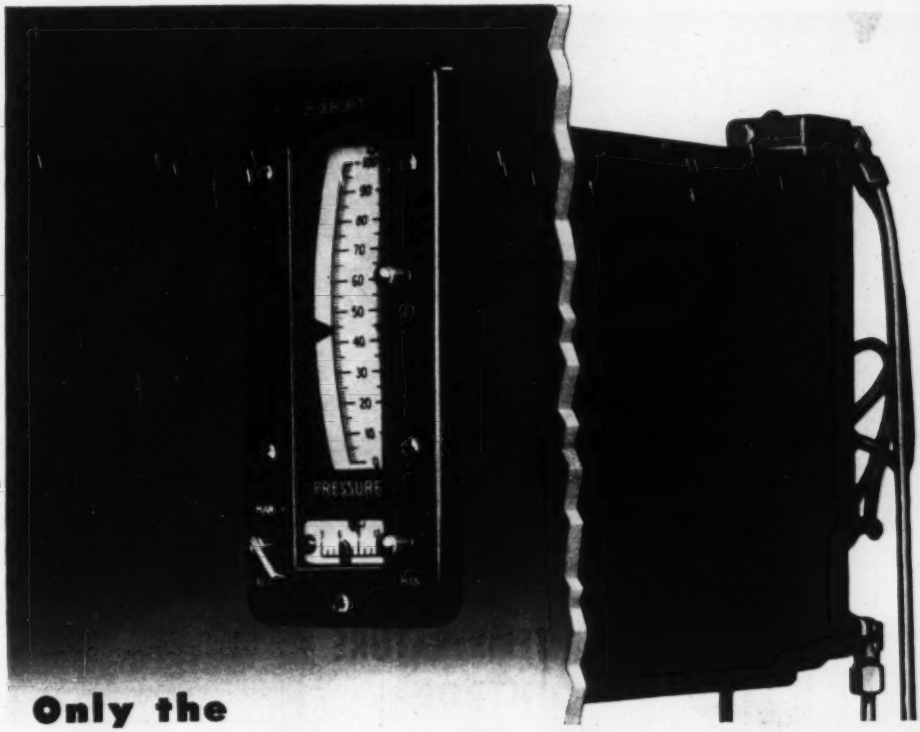
COMPANY LTD.
Hamilton, Ont., Canada



Only the CONSOTROL M/52 gives you all these advantages!

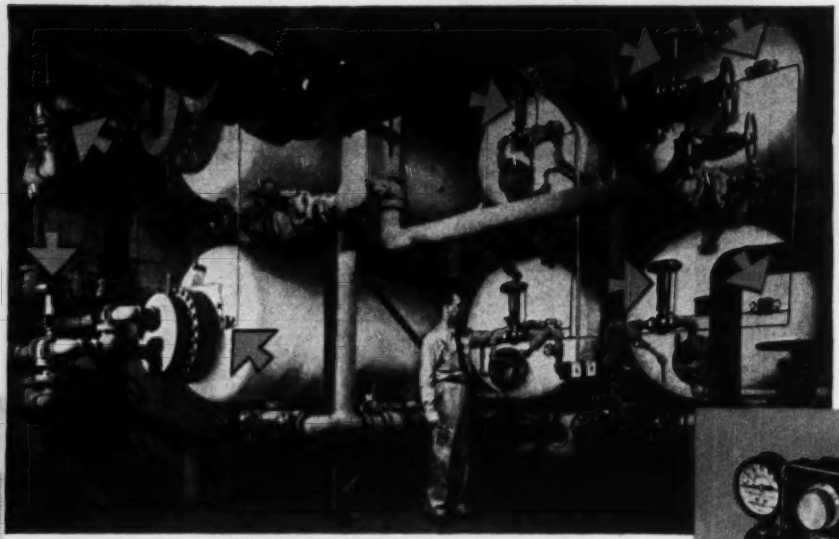
For indicating control functions in your console or graphic panel instrumentation, no other controller offers so much for so little money as the Foxboro Consotrol M/52 Indicating Controller. Compare these combined advantages:

1. **A completely self-contained, compact, panel-mounted Indicating Receiver Controller** that costs up to 20% less, installed, than usual graphic panel indicating control.
2. **Simple installation** — only 2 connections besides the air supply.
3. **Pull-out feature** that provides complete accessibility of control mechanism from front of panel.
4. **Instrument-type pressure transmitter for driftless** remote manual control, instead of usual pressure regulator.
5. **Simple 2-position transfer switch** and "foolproof" transfer indicator provide absolutely bumpless transfer.
6. **Graphic panel compactness** — takes only 3¾" x 7⅞" of panel space.
7. **"Full-size" performance** — control action unsurpassed by the finest conventional-size controllers. Available in Proportional, Proportional with Reset, Proportional with Derivative, Proportional with Reset and Derivative, and On-Off.
8. May be used with separately-mounted recorder using conventional circular charts. Up to 6 records may be combined on one chart with the Foxboro Multi-Record Recorder. (Consotrol Recorder-Controllers, featuring full scale 4" strip charts, also available.)

Get full details of this space-saving, cost-saving instrumentation. Write for Bulletin 463 describing the complete Consotrol Line of graphic panel instruments. **The Foxboro Company, 18210 Neponset Ave., Foxboro, Mass., U.S.A.**

FOXBORO
REG. U.S. PAT. OFF.

RECORDING · CONTROLLING · INDICATING
INSTRUMENTS



Chief Engineer Edward MacDonald states "Performance of Powers Accritem Temperature Regulators has been highly satisfactory on the 6 water heaters shown above as well as on booster heater for dishwasher and for controlling cooling of condensate before discharge to sewer."

WATER HEATERS AT LEVER HOUSE New York City

Architects: Skidmore, Owings & Merrill

Consulting Engineers: Jaros, Baum & Bolles

Contractor: Gilman-Rous-Pesce Corp.

LUX TOILET SOAP

One of Lever Brothers Co. Famous Soaps

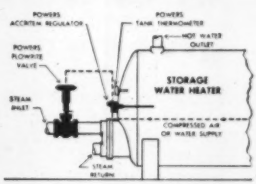
Powers ACCRITEM Regulator Compressed Air or Water Operated

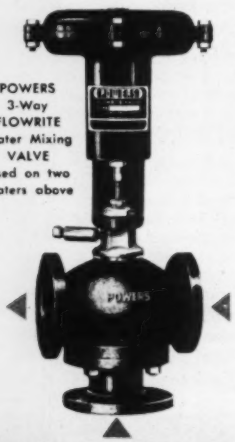
POWERS WATER TEMPERATURE CONTROL

ACCRITEM Regulators were selected for LEVER BROTHERS beautiful modern building on Park Avenue in New York City. The air conditioning system here is also Powers controlled.

Water heaters in more and more prominent buildings are being equipped with Powers Accritem Regulators because of their —

Unsurpassed for reliability and power to operate large or small diaphragm valves controlling Water Heaters, Heat Exchangers, Jacket Water Cooling for Diesel Engines or Air Compressors and many Industrial Processes.





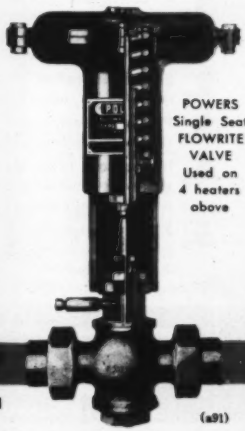
POWERS 3-Way FLOWRITE Water Mixing VALVE Used on two heaters above

Important Features that Give Better Control and Lower Maintenance

- ***Adjustable Sensitivity*** and over-heat protection.
- ***Calibrated Dial*** temperature adjustment.
- ***Simple, Rugged Construction*** withstands vibration and insures years of reliable service.
- ***Temperature Ranges*** 50-250° F. and 150-350° F.
- ***Easy to Install.*** Requires 15 lb. supply of compressed air or water for its operation.
- ***Small Size***—regulator head is only 2⅞" x 3⅜", sensitive bulb is 12" long with ½" I. P. S. connection.

Bulletin 316 gives full details

Call Powers for aid with your problems of temperature control. Our more than 60 years of experience may be helpful to you. Whether you want a simple self-operated regulator or thermostatic water mixing valve or a pneumatic control system with recording controllers...contact Powers.



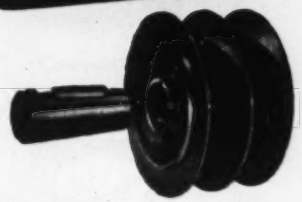
POWERS Single Seat FLOWRITE VALVE Used on 4 heaters above

THE POWERS REGULATOR COMPANY

Skokie, Ill. • Offices in Over 50 Cities, See your phone book • Established 1891

(a91)

TEXROPE

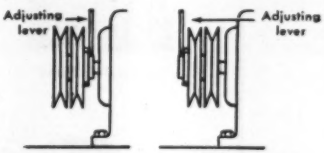


1 Magic-Grip Mounting

The widely used *Magic-Grip* tapered bushing is now supplied with the Wide Range *Vari-Pitch* sheave, making it the fastest mounting sheave of its type on the market. Turning only one screw makes or breaks the vise-like grip of sheave bushing on motor shaft.

2 Fast Adjustment

To change sheave diameter — thereby changing speed — simply turn a single adjusting screw, *using a lever rod* that slips through a hole in the head of the screw. No more fumbling with screw drivers. Adjustment is fast and accurate.



3 Adjusts From Either Side

Sheave can be mounted on motor shaft so adjusting screw is either toward or away from motor bearing, as indicated above. This feature is especially important in installations where space for adjustment is limited. It's the only sheave of its type with this feature.

A stationary control sheave for use with Q or R section belts on 1½ to 30-hp drives.

NOW!

Wide Range has 3 New Advantages

GET COMPLETE DATA FROM YOUR NEARBY ALLIS-CHALMERS DISTRIBUTOR OR DISTRICT OFFICE, OR SEND COUPON.

ALLIS-CHALMERS
MILWAUKEE 1, WIS.

Send me complete specifications and engineering data on the new Wide Range *Vari-Pitch* sheave . . . 20S7811

Name.....

Title.....

Company.....

Street.....

City..... State.....

A-3841

Texrope, Vari-Pitch and Magic-Grip are Allis-Chalmers trademarks.

ALLIS-CHALMERS

American Blower...a time-honored name in air handling

New York City has a conveniently located American Blower Branch Office to provide you with data and equipment for air handling. You can reach American Blower in New York by calling BRyant 9-2885. In other cities, consult your phone book.

YARN ABOUT YARN . . .

A textile manufacturer was continually changing pulleys or setting the machine rate on his ring-spinning frames to fit the material that worked at the lowest speed. He'd heard about American Blower Gyrol Fluid Drives and decided to try them. Results were amazing. Gyrol Fluid Drive permitted a higher output within safe limits of the material, allowed spinning frames to start gradually with less yarn breakage. For your business, wouldn't smooth power transmission and adjustable speed control be a distinct advantage?

FOOD FOR THOUGHT . . .

Those magnificent new supermarkets springing up around the country are just as comfortable as they are modern. Many use American Blower Ventura Fans for ventilation the year round, and Venturafin Unit Heaters for winter heating. They meet a twofold requirement. First, both units are beautifully styled to harmonize with modern designs. Second, both units are quiet-operating—a necessity in modern stores. Our nearest branch office will be glad to furnish price and delivery data.

FUMES, VAPORS, GASES . . .

In addition to a wide range of standard ventilating equipment for industry, American Blower also offers special fans to handle corrosive gases, fumes, vapors. Some corrosive gases are vital to process work and must be circulated in the system with corrosion-resistant fans. Gases and fumes which affect the health and comfort of employees must be removed. There is an American Blower corrosion-resistant fan that will meet your requirements for those special applications in the process industry.

Whatever your needs, American Blower heating, cooling, drying, air conditioning and air handling equipment will improve over-all comfort and efficiency in your business. For data, phone or write our nearest branch office.

Unit Heaters

Ventura Fans

Air Conditioning Equipment

Industrial Fans

Utility Sets

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

YOUR BEST BUY **AMERICAN BLOWER** AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

OILGEAR DRIVES ON GLAMORGAN CENTRIFUGAL PIPE CASTING MACHINE

Something more than 5 years ago, the Glamorgan Pipe & Foundry Company, of Lynchburg, Va., a leading manufacturer of cast iron pipe, designed its own centrifugal pipe casting machine, using Oilgear Fluid Power equipment to tilt the ladle and move the casting carriage.

The degree of control over pouring rate and carriage travel afforded by Oilgear has had almost unbelievable results. Scrap caused by irregularities in moving parts has become negligible. Weight controls are well within the close limits set by Industry specifications. Only 3 men are needed to operate the equipment. Despite the fact the machine has averaged 500 operations per day since 1948, maintenance on Oilgear equipment has totaled less than $200.00. The fumes and dirt necessarily present in foundry operations have had no effect on Oilgear fluid power equipment.

TYPICAL OF OILGEAR'S ABILITY TO SOLVE MACHINE DESIGN PROBLEMS

Sure it takes power to tilt a ladle and move a pipe casting machine carriage. But above all, it takes absolute and precise control of the speed of pouring and the speed of carriage travel if the product is to be perfect and uniform.

It not only takes power but power under control to print in register on flimsy cellophane at high speed, to set up paper piles for repetitive serial cuts to hairline register automatically, to cut fish on a continuous conveyor to accurate weight for canning, to vary the speed of a large beater automatically to conform sensitively to the changing viscosity of the mass.

These are all triumphs of Oilgear Fluid Power—where this flexible, controllable, versatile power leads the way to better machine design or to the solution of hitherto unsolved problems.

Think of Oilgear Fluid Power as identical with electrical power . . . generated by a pump . . . applied over conductors through a motor or motor element. But Oilgear Fluid Power can be converted into linear movement as well as rotary; can be exerted statically, without motion; can be varied infinitely, steplessly without additional equipment.

And the unique Oilgear design is oil hydraulic design at its simplest and best. It is generally accepted as the leader in its field. It will cost you nothing to see what Oilgear can do to improve the salability of your equipment . . . may profit you and your users in an amazing degree. THE OILGEAR COMPANY, 1570 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

OILGEAR

SEALING

WICKING

POLISHING

FILTRATION – AIR

HERE ARE 16 OF THE CARDINAL

16 uses for FELT

HOW MANY ARE YOU USING?

FELT does many things, so many that probably every day of your life it serves you in some way or another, directly, as in the grease retainers in your car, or indirectly, to make possible your eyeglasses. Illustrated here are 16 of the cardinal mechanical applications, one or more of which should be used to advantage in your product or plant. We invite full investigation. American Felts include hundreds of types for thousands of uses. Each type is held to strict specifications and standards. American Felt maintains an experienced engineering staff, ready to assist you with technical data, or to collaborate with you in selecting and using the correct felt for a given application. Samples are available. Get in touch with American, and discover what modern felt techniques can do for you.

American Felt Company

TRADE MARK

GENERAL OFFICES: 50 GLENVILLE ROAD, GLENVILLE, CONN.
SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal. — PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.— ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

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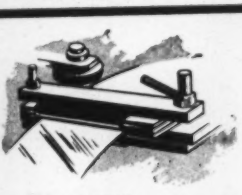
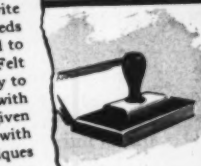
FILTRATION—FLUIDS

SOUND ABSORPTION & THERMAL INSULATION

SHOCK ABSORPTION

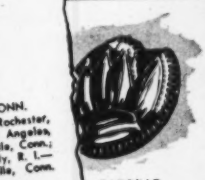


WIPING



MOISTENING

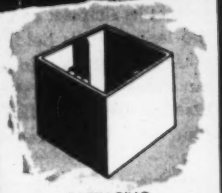
CUSHIONING



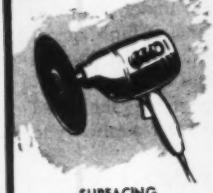
PADDING

PERCUSSION

VIBRATION CONTROL
SEND FOR BOOKLET



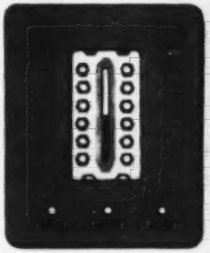
PACKAGING



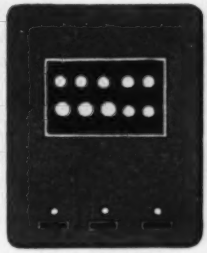
SURFACING

FRICTIONAL

Rapidly Growing LIST OF UTILITIES Using the DIAMOND "UTILISCOPE" (WIRED TELEVISION)



Boiler water level observation



Burner pilot observation

Boiler furnace combustion observation

Stack smoke discharge observation

Utilities listed below have purchased the Diamond "Utiliscope" for one or more of the uses shown. Images are brought to the boiler control panel where the operator can see them at all times.

***Ohio Power Co.**
Tidd Station
Muskingum River Plant

***Consolidated Edison Co.**
Hellgate Station
Hudson Avenue Station
Waterside Station
East River Station

***Commonwealth Edison Co.**
Fisk Street Station
Ridgeland Station

***Board of Water & Electric Light Comm.**
Ottawa Station,
Lansing, Mich.

***Cincinnati Gas & Electric Co.**
Miami Fort Station
Clermont Station
Walter C. Beckjord Station

***Illinois Power Co.**
Wood River Station

***Oklahoma Gas & Electric Co.**
Mustang Station

***Indiana & Michigan Elec. Co.**
Twin Branch Station
Tanners Creek Station

***Appalachian Electric Power Co.**
Phillip Sporn Station
Kanawha Station
Graham Station

***Northern Indiana Public Service Co.**
Michigan City Station

Public Service Co. of Indiana
Noblesville Station

Union Electric Power Co.
Venice Station

Northern States Power Co.
Minneapolis Station

***Dayton Power & Light Co.**
Hutchings Station

Buffalo-Niagara Electric Corp.
Huntley Station

***Duke Power Co.**
Dan River Station
Lee Station
Riverbend Station

Union Electric Co. of Missouri
Meramac Station

Elecktricitateetssakskabet
Kydnby Power Station
Isefyordraerkat,
Denmark

***Niagara Mohawk Power Corp.**
Dunkirk Station
Oswego Station
Huntley Station
Albany Steam Station

The "Utiliscope" is simple, stable, remarkably durable. It requires no technical skill for operation. Cost is low and is quickly amortized by labor saving and improved operation. Write for Bulletin 1025 AA.

***Societa Edison—Centrale diGenova**
Genova, Italy
Piacenza, Italy

Central Hudson Gas & Electric Corp.
Danskammer Station

***Tennessee Valley Authority**
Johnsonville Steam Plant
Widows Creek Plant
Shawnee Steam Plant
Kingston Steam Plant

Chicago District Electric Generating Corp.
State Line Station

***Public Service Co. of N. Illinois**
Station No. 6
Dixon Station

Kansas Gas & Electric Co.
Murray Hill Station

***Long Island Lighting Co.**
Port Jefferson Station
Far Rockaway Station
Glenwood Landing Station

Toledo Edison Co.
Acme Station

***Philadelphia Electric Co.**
Delaware Station
Richmond Station

Cleveland Electric Illuminating Co.
Eastlake Plant

Indianapolis Power & Light Co.
White River Station

Virginia Electric Power Co.
Chesterfield Station

***Southern California Edison Co.**
Etiwanda Station

San Diego Gas & Electric Co.
Silver Gate Station

Monongahela Power Co.
Albright Station

***Electricite de France**
Nantes Chivire Station
Arrighi Station

***New York State Electric & Gas Corp.**
Goudey Station
Greenidge Station

**Repeat orders have been received from these utilities.*

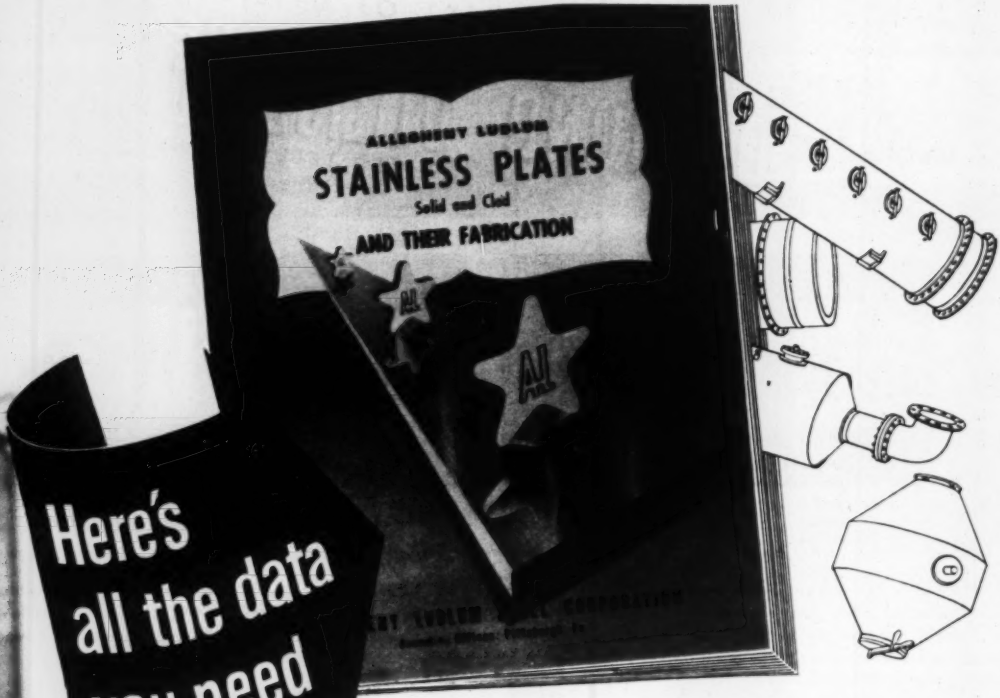
"UTILISCOPE" REGISTERED U. S. PATENT OFFICE

DIAMOND POWER SPECIALTY CORP.
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO • *OFFICES IN 39 PRINCIPAL CITIES*
Diamond Specialty Limited — Windsor, Ontario

WRITE FOR BULLETIN 1025

Since 1903, Diamond has Manufactured Quality Equipment For Industry

4831



on Allegheny Metal Plates

For certified data on individual grades of Stainless Steel, use

ALLEGHENY LUDLUM BLUE SHEETS

There is a Blue Sheet for each individual grade of Allegheny Metal, giving full information on its physical and chemical properties and characteristics. Let us send you this certified, laboratory-proved data on the stainless grades in which you are interested.

ADDRESS DEPT. ME-34

WRITE FOR YOUR COPY!

For any job which involves the handling of large volumes, heat and high pressures—either singly or all at one time—Allegheny Metal solid or clad plates are produced in the exact stainless grade required to combat corrosion, oxidation and contamination of the product.

Some of these grades are *new* . . . comparatively recent developments of our research and experience as a pioneer and leader in stainless steel production. Others are improved versions of older analyses. The latest information on the entire subject of stainless plates is available to you in the booklet illustrated above—32 pages of valuable data on types, sizes, finishes, fabricating methods and uses, including ASTM and ASME boiler codes.

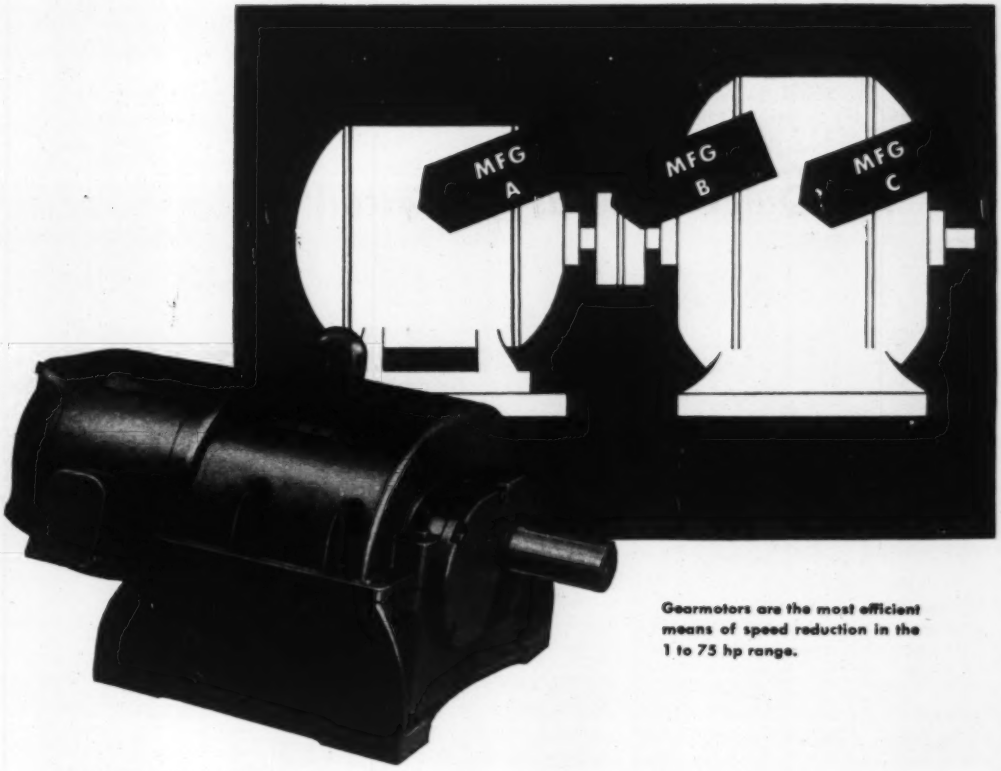
Specify "Allegheny Metal" for complete reliability in stainless steel plates, and write for your copy of the A-L Plate Book. ● *Address Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*

You can make it **BETTER** with

Allegheny Metal

WAD 4877

TIME-TESTED STAINLESS STEEL



Gearmotors are the most efficient means of speed reduction in the 1 to 75 hp range.

Life-Line GEARMOTORS mean only ONE call for selection . . . ordering . . . maintenance

"Get me the local Westinghouse office, please!" In those few words lies the answer to *all* your speed reduction problems. Every component of a Life-Line gearmotor is made and serviced by one manufacturer—Westinghouse. Regardless of what you need you make only one call with Life-Line.

Also, that one call connects you with the most complete nationwide service organization. A ready supply of gearmotor parts—complete facilities to handle every phase of gearmotor repair work—a large staff of field engineers to consult or help you with your drive operating problems.

Eliminate service confusion with Life-Line gearmotors. Ask your Westinghouse representative for full details. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-07312

Easy to Order! . . .

. . . Quick and Easy to Install!

Grinnell Welding Fittings

Any qualified welder can make welds quickly and easily with Grinnell welding fittings. These fittings are made by a hydraulic forging process that assures uniform wall thickness at all points and true circularity throughout. Of seamless, one-piece construction, they can be cut at any angle to match up with standard weight, extra strong and heavier wall pipe in I.D. or O.D. sizes. Pressure-temperature ratings are equal to or greater than those of seamless steel pipe. Grinnell welding fittings are process stress-relieved.

Full data on the complete line of Grinnell seamless carbon steel welding fittings and forged steel flanges is contained in the Grinnell Welding Fittings catalog. Send for a copy.

GRINNELL
WHENEVER PIPING IS INVOLVED

RANGE OF TYPES AND SIZES

Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge: Nominal Pipe Size	Light Gauge: Iron Pipe Size
ELBOWS 90° Long Radius	½"-30"	½"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
90° Long Tangent	1½"-12"	1½"-12"	.....	.....	.....	.....
90° Reducing	2"x¾" to 6"x5"		.....	.....	.....	.....
90° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
45° Long Radius	½"-30"	¾"-30"	1"-12"	¾"-8"	4"-24"	¾"-12"
RETURNS 180° Long Radius	½"-30"	½"-30"	1"-12"	2"-8"	4"-24"	¾"-12"
180° Short Radius	1"-30"	1½"-30"	.....	.....	.....	.....
180° Ex. Long Radius	1"-2½"	1"-2½"	.....	.....	.....	.....
TEES — Straight	½"-24"	½"-24"	½"-12"	½"-8"	.....	.....
Reducing Outlet	½"-24"	½"-24"	¾"-12"	¾"-8"	.....	.....
REDUCERS Concentric & Eccentric	¾"-24"	¾"-24"	¾"-12"	¾"-8"	.....	.....
CAPS	¾"-24"	¾"-24"	1"-12"	1"-8"	.....	.....
STUB ENDS — Lap Joint	½"-24"	½"-24"				
SADDLES	2"-24"					
LATERALS — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
CROSSES — Straight	1¼"-24"	1¼"-24"				
Reducing	1¼"-24"	1¼"-24"				
BACKING RINGS	2"-24"	2"-24"				

Also available in certain sizes are: 90° long and short radius elbows, 45° long radius elbows and 180° long and short radius returns in Schedules 30, 40, 60 and 80.

Grinnell welding fittings and flanges conform to applicable ASA and ASTM Standards.

GRINNELL WELDING FITTINGS ARE QUALITY-CONTROLLED FOR DEPENDABILITY

TRUE CIRCULAR SECTION

True circular section at all points makes a Grinnell fitting easy to align and weld . . . there is no distortion or no flattening to affect flow adversely.

FULL EFFECTIVE RADIUS

The loss of pressure through Grinnell welding elbows is held down to an absolute minimum . . . because of the full and the effective sweep of the radius.

SMOOTH, CLEAN INSIDE SURFACE

Grinnell Fittings have uniformly smooth inner walls . . . no waves or ridges to cause turbulence or accelerate erosion or corrosion. No pockets to trap solids.

EASY, SWEEPING TURNS

In Grinnell welding tees, corners where outlet joins the run are well-rounded and perfectly smooth to minimize resistance to flow and to prevent trapping.

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

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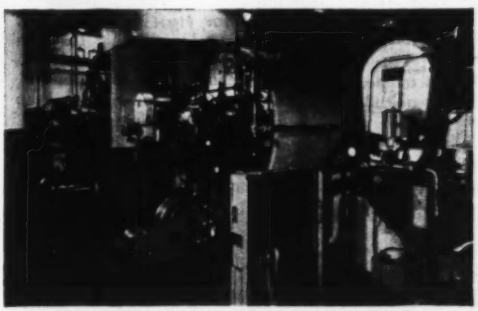
In this modern newspaper building passersby can see running presses through 11 ft. plate glass windows, located directly behind flag pole in this picture.

WASHINGTON POST BUILDING, Washington, D. C. Albert Kahn Associated Architects and Engineers, Inc. John McShain, Inc. — General Contractor. Standard Engineering Company, Engineers and Contractors.

THE WASHINGTON POST'S new 7-story building is heated by a combination of a hot blast ventilating system for the inside areas and convector radiation along the outside walls. The steam distribution system is divided into two sections, one supplying the fan blast coils at 3 lbs. to 5 lbs. pressure and one supplying the radiation at 3 lbs. to 5 lbs. pressure.



Three Cleaver-Brooks 150 hp., oil-fired, self-contained boilers were easily and quickly installed in low headroom, basement space.

Three Cleaver-Brooks 150 hp. oil-fired, self-contained boilers, installed in the basement location, supply steam for the entire heating system.

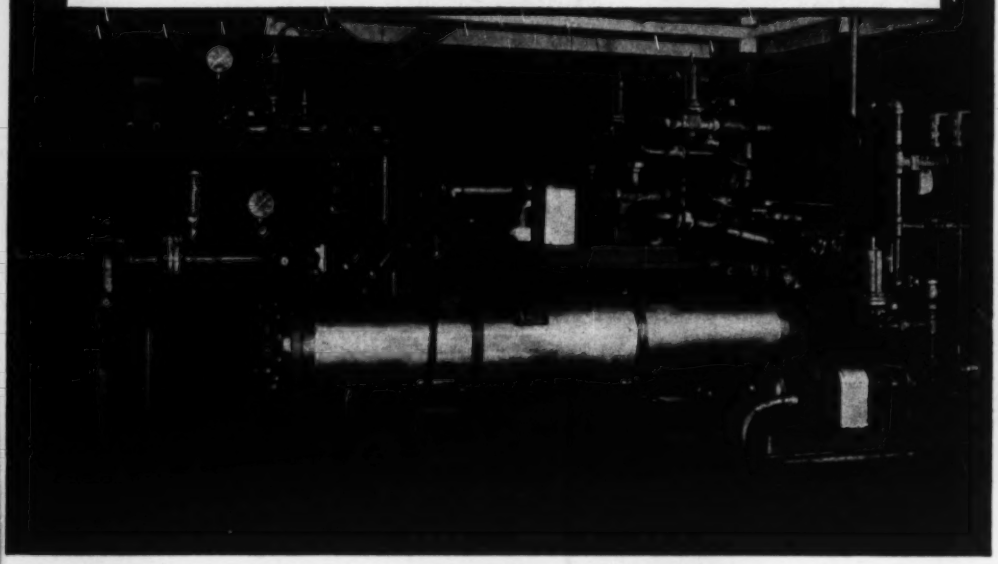
Modern Cleaver-Brooks boilers are increasingly specified for heating service. Completely self-contained and compact in design, requiring minimum headroom and floor area, Cleaver-Brooks boilers offer many installation and operating advantages — oil, gas, or combination oil and gas firing — fully automatic — clean — dependable performance — operate at a guaranteed efficiency of 80%. Available in sizes from 15 to 500 hp., 15 to 250 psi.

Write for the latest, fully illustrated Steam Boiler Catalog — Cleaver-Brooks Company, Dept. L-318 East Keefe Avenue, Milwaukee 12, Wisconsin, U.S.A. *Cable address*: CLEBRO-Milwaukeewis.

Cleaver-Brooks
Originators of Self-Contained
STEAM BOILERS

Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

2 separate ENCO Fuel Oil Units Meet Plant Needs



Here is a typical Enco two-unit installation which handles fuel oil pumping and heating requirements in the plant of a building materials manufacturer.

Fuel Oil Pumping and Heating Unit, built with two pumps and two heaters, is designed for continuous plant load service. Capacity is 11 gpm Bunker C fuel oil with one pump or one heater at 300 psig pressure with a temperature rise from 90F to 230F.

Light Oil Pumping Unit for cold start-up service. Capacity is 3 gpm #2 oil at 300 psig pressure.

Enco pump sets are designed to give you easier control and longer maintenance-free operation. They are simple and economical to install. All you need do is to connect to station piping and run. Before shipping, every Enco Fuel Oil Pumping and Heating Unit is completely tested under high pressures. For complete details on wide-range line, write for Bulletin O B-37.

Only ENCO offers all ten plus features

1. Completely Automatic Operation is assured by automatic temperature and pressure regulation valves.

2. Coordinated Design Saves Space. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.

3. Individually Designed to meet the specific needs of the particular power plant in accordance with its exact operating requirements.

4. All Parts Visible and Accessible for easy operation, maintenance and repair.

5. Pumps and Heaters are interconnected to provide maximum flexibility of operation.

6. Safety Valves protect individual parts where required.

7. Easier Maintenance — Less Service-Time for Cleaning because straight tube, multi-pass heaters with removable heads are used.

8. Pumps Operate at Moderate Speed. Heaters designed to give the correct viscosity and velocity without fouling.

9. Smoother Flow of Clean Fuel to Furnace. Air chamber for each piston pump prevents pulsations—pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.

10. Cleaner Boiler Room . . . all overflows connected to a common outlet, flanged drip pan catches oil drip.

EC-485

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

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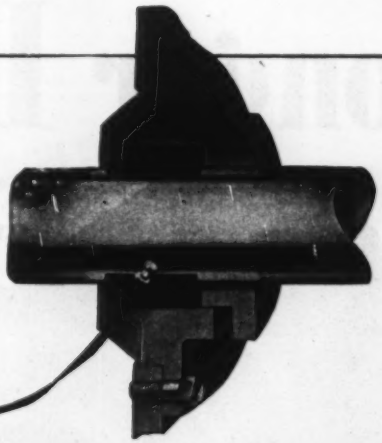
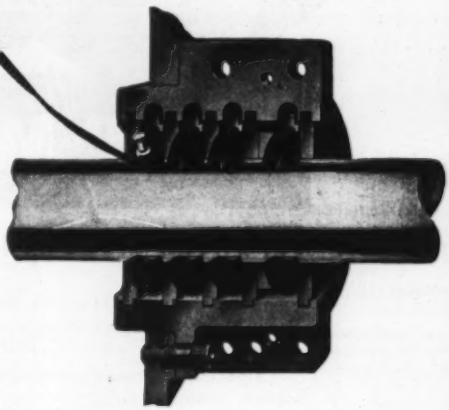
offer you a choice of packing rings



STANDARD METALLIC RING PACKING — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.



OPTIONAL CARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

FIT TURBINE COSTS TO HORSEPOWER NEEDS

When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .

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THOMAS' REGISTER

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Longer Life...

designed and built for *extra* operating stamina

"The Finest Money Can Buy!"

DENISON Hydraulics

PUMP/MOTOR

For circuit needs up to 2000 psi

Every feature of Denison's compact, dual-purpose Pump/Motor is designed to *stand up longer* under continuous, heavy-duty service at 2000 psi.

Hydraulically balanced vane and rotor action means smooth, uniform, radially balanced operation. It assures minimum wear on both the vanes and the cam ring, and reduces surge and pulsation to a minimum. For added assurance of higher efficiencies, vanes are designed to contact the cam ring with *dual sealing edges.*

Four sizes, each offering a series of interchangeable cam rings, provide capacities to meet your specific need. Operating at 1200 rpm and 2000 psi, they offer pumping capacities from 2.7 to 70 gpm. As *motors,* their torque ratings range from 13 to 257 pound-inches per 100 psi. And all models are *ready to operate* as either pumps or motors, without alterations of any kind.

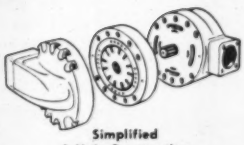
Wherever you need rugged power for circuits developing up to 2000 psi, Denison Pump/Motors offer the finest money can buy. Write today for bulletin P-5.

Complete Radial Balance

Hydraulically balanced vanes reduce load on the cam ring and retain low loading characteristics at all operating pressures. In addition, twin exhaust and inlet ports provide radial balance for the rotor. The combination of balanced vane and rotor give you that extra margin of long, trouble-free service under all conditions.

Bi-Directional Operation

All Pump/Moter models may be used for either clockwise or counter-clockwise rotation—operating with equal efficiency in either direction!



Simplified 3-Unit Construction

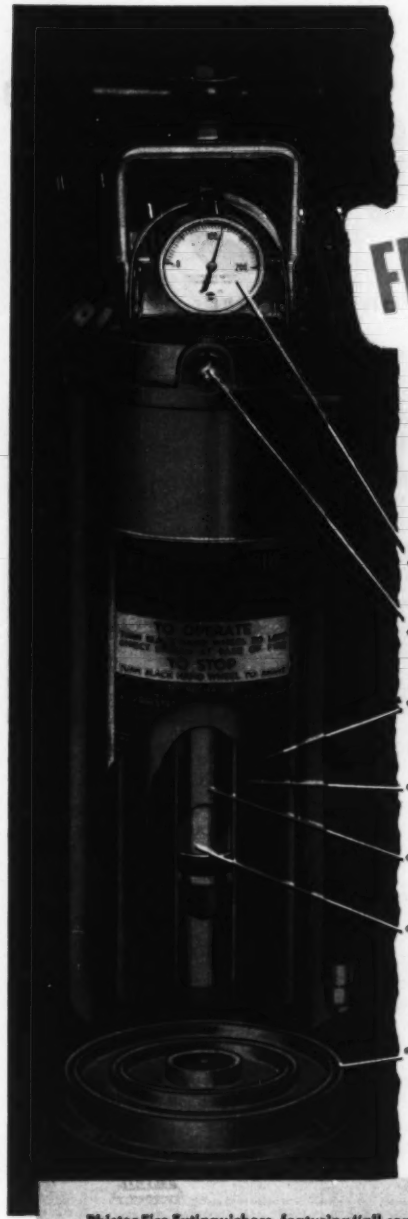
Simplified construction featuring only three major components — with interchangeable cam rings for each different pumping cartridge — add still further to the versatility and long service life of Denison Pump/Motors.

Rugged, Space-saving Compactness

Compact construction makes Denison Pump/Motors easier to adapt to any circuit plan. Model TMB12, shown above, delivering up to 7.5 gpm at 2000 psi is only 4⅛" high, 4⅛" wide, and 8" long including the shaft.

The DENISON Engineering Company

1189 Dublin Rd., Columbus 16, Ohio


AIR PRESSURE GAGE
LIQUID LEVEL INDICATOR
LIQUID CHAMBER OUTER SHELL 8" O.D. x .050" SEAMLESS COPPER TUBE
COMPRESSED AIR CHAMBER
SEAMLESS COPPER TUBE PUMP CASING
SEAMLESS BRASS TUBE HAND PUMP (FOR RECHARGING; AIR-LINE CONNECTION IS IN BONNET)
CAST RED BRASS BASE AND BONNET (TUBE GROOVES ARE MACHINED)

"BUILT-IN" FIRE-FIGHTING POWER *that lasts*

In the home or plant, the cry of "fire" is always frightening, and infinitely more so if the extinguisher fails to work.

Based on several such experiences, and goaded by the conviction that "any fire costs more than a dependable fire extinguisher," founders of The Phister Manufacturing Company of Cincinnati, way back in 1918, decided to design an extinguisher "superior to any on the market" and combining these four *musts:*

1. It must maintain constant air pressure—without pumping.
2. It must be ready to go into operation instantly . . . even after years of disuse.
3. Air pressure and liquid level gages must indicate condition at a glance.
4. Most important, dependable, corrosion-resistant metals must be used to eliminate the most common cause of failures.

Since the first Phister Extinguisher was built to these specifications, there has not been a single record of failure by corrosion.

Over the years, The American Brass Company has supplied Phister with Anaconda Copper and Copper Alloys in many commercial forms, filling precise requirements of corrosion resistance, close-tolerance dimensions and low-cost fabricating qualities. Perhaps our Technical Department could work with you in a similar way? Write The American Brass Company, General Offices, Waterbury 20, Connecticut. 9201

Phister Fire Extinguishers, featuring "all copper and brass construction," are made in a variety of portable sizes and are readily recharged after use. Copper and copper-alloy components provide high resistance to corrosion. Other Anaconda Alloys are used for valve parts, packing nuts, couplings, bushings, gage guards, hose clips, pump parts, etc.

You can depend on

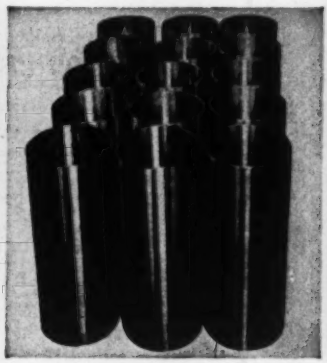
ANACONDA

COPPER & COPPER ALLOYS

for [illegible]rong, hard, heat- and corrosion-resisting Castings

—consider MONEL, NICKEL and INCONEL

SAND CASTINGS



CENTRIFUGAL CASTINGS

PRECISION CASTINGS

If you want castings that must show long life—even under severe corrosive, thermal and mechanical conditions—investigate problem-solving Monel, Nickel and Inconel.

These Inco Nickel Alloys resist corrosion by most acids, alkalies and salts; they have the hardness needed to withstand abrasive and erosive attack; they are strong at high temperatures, at low temperatures.

"S" Monel's high hardness and resistance to galling make it a favorite material for all wearing surfaces where erosion is a factor. "H" Monel is used where better ductility is required on mildly abrasive applications.

Inco will supply the castings to your order from our own foundry at Bayonne, N. J. This foundry is maintained as a service to users of Nickel alloys.

Here, your order gets *double* expert attention. Attention by expert foundrymen; attention by foundrymen who are experts in casting high-Nickel alloys.

At present much of Inco's production is being diverted to defense and you may not be able to get immediate delivery. However, our expert foundrymen are always ready to help you with your special casting problems, whether they be sand, centrifugal or precision.

Pass the details along to Inco at the address below. Let us work it out with you to see how economically it can be solved by use of high-Nickel alloys.

PRECISION CASTINGS ARE PRODUCED IN THESE METALS

Monel®
"H" Monel
"S" Monel
Nickel
Inconel®
Ni-Hard®
Ni-Resist®
Stainless Steels
SAE, AISI, NE Steels
Tool Steels
Copper-Base Alloys
Cobalt-Base Alloys

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INCO
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THE INTERNATIONAL NICKEL COMPANY, Inc., 67 Wall Street, New York 5, N. Y.

Think of Inco for Castings in durable metals

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 74 NUMBER 10

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Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members and affiliates one year $3.50, single copy 50 cents, to nonmembers one year $7.00, single copy 75 cents. Extra postage to countries not in the Pan-American Union, $1.50; to Canada, 75 cents. Changes of address must be received at Society headquarters four weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1952, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulations. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author, and that date of publication be stated.

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Tank-Type Vacuum Cleaner Is Shown Being Tested in New Sound Laboratory for Studying Noise—Its Source, Cause, and Measurement

(*Built by Westinghouse Electric Corporation, Pittsburgh, Pa., the room, called an anechoic chamber, is surrounded by 12-in-thick masonry walls. It is 19 × 13 × 10 ft in size, and its walls, roof, and floor are completely covered with a glass wool insulating material in the form of wedges. These wedges, 8 × 24 in. at the base and 34 in. long, are the heart of the anechoic chamber. Their shape, composition, size, and number determines the room's efficiency.*)

VOLUME 74
No. 10

MECHANICAL ENGINEERING

OCTOBER
1952

GEORGE A. STETSON, *Editor*

Two Days at the Centennial

AS THIS is being written the great Centennial of Engineering is getting under way and gathering momentum. It commemorates the one hundredth anniversary of the founding of the American Society of Civil Engineers, the first national engineering society to be organized in the United States.

It was the plan of the ASCE not to concentrate public attention on themselves alone but upon all engineering societies of the nation and on the engineering profession. Hence the event itself is a combination of numerous and varied elements. The general convocation program, a book of more than 260 pages, lists the individual programs of 65 engineering organizations which were meeting in Chicago, Ill., from Sept. 3 to 13, 1952. It includes also the Symposium program in 12 sections, which was designed to enhance "public appreciation of engineering and its contributions to development of the United States and the advancement of civilization and a better understanding of the basic reasons why our nation has risen so rapidly to its position of world prominence." It mentions also some of the more spectacular and popular features of the Centennial: The motion picture "Miracles for Millions;" the exhibit at the Museum of Science and Industry; the stage production, "Adam to Atom," a musical review "portraying mankind's advance over the ages, designed especially to give the public a better understanding of the engineer's role in our land of opportunity;" the commemorative postage stamp issued by the United States Post Office Department; the field inspection trips; and the tours arranged for the entertainment of the women.

A single observer, overwhelmed by the extent and variety of the Centennial and unable to be in more than one place at a time, cannot, after two days of an eleven-day program, render a comprehensive report. In those two days he listened to seven papers on the role of the organized profession, and 21 papers and discussions on education and training, the first two sections of the Symposium program. If there were any pattern to be found in the material presented, it was confined to a general plan, considerable attention being paid to historical background, and to achievements, and some attention to future trends. But, as would be expected where engineers are concerned, there was a wide variety of opinion and emphasis. So crowded was the program on both days that no time was available for discussion from the floor or for questions. The remaining sections of the Symposium program schedule include seven papers on food, six on tools, twelve on transportation, ten on the mineral industries, seven on structures and construction, eight on the chemical industries, nine on communications, ten on energy, seven on health and human engineering, and four on urbanization. Were all of this material to be published, it would provide an interesting survey of the contributions of engineering to our way of life, complete and well integrated as to plan even if not in emphasis and execution.

The section on the role of the organized profession, under the chairmanship of Harry S. Rogers, president, the Polytechnic Institute of Brooklyn, covered the five great national engineering societies of civil, mining, mechanical, electrical, and chemical engineers, with an exposition of the part played by military engineers, and a synthesizing summary on the intersociety role. In its scope this program covered in broad outline much more than the one hundred years that have elapsed since 1852, for it began with the great master builders of Egypt and Mesopotamia, and moved westward and down to our present times through Greece, Rome, France, England, and the United States. If any one impression were stronger than others as this vast pageant of progress was unfolded, it was a sense of the high ideals of dedicated service which characterized the great engineers of all ages and all lands and the noble qualities and versatile accomplishments of these benefactors of mankind. As we contemplate this heritage and the conditions and needs existing today, we become conscious of a profession destined to play an increasingly important role in human society and in process of rapidly expanding a tremendous variety of useful knowledge and skills, and of developing at the same time a unity of purpose, method, and organization.

In the second section, on education and training, broadly planned and ably administered by Dean A. A. Potter of Purdue, the long history of the subject was sketched briefly by Frederic T. Mavis, of the Carnegie Institute of Technology, from the days of Tubal-cain, "instructor of every artificer in brass and iron," to the present. He quoted the words of the Roman engineer, Vitruvius, twenty centuries ago, to the effect that engineers "who, without culture, aim at manual skill, cannot gain a prestige corresponding to their labors, while those who trust to theory and literature obviously follow a shadow and not reality." This statement parallels closely the more recent concept of the engineer as one who bases his work on the theories and discoveries of science on the one hand and the skills of the mechanic arts on the other, draws heavily on an accumulated experience and practice, and seasons both his empiricism and imagination with courage, sound judgment, and a balanced sense of

practicality and cost-consciousness. "Our engineering heritage," said Professor Mavis, "is in large measure the realism and strength and courage that one must acquire if he is to work in the vanguard of inevitable change. In dealing with the caprice of Mother Nature the engineer has been pretty successful; in dealing with the cussedness of human nature he has limitless challenges and opportunities ahead of him."

In an able review of achievements in engineering education, Thorndike Saville presented a brief but well-balanced summary which should be useful in acquiring a sense of perspective based on facts and trends.

"It should be clear," he said, "that progress in engineering education has been substantial, and that achievements are significant and numerous. But it is equally obvious that serious problems still confront us, of which curriculum content, proliferation of curricula, length of undergraduate curriculum, postgraduate education, and selection and guidance are among the more important. The ASEE and ECPD have recognized this challenge, and there was established by ASEE in June, 1952, a Co-Ordinating Committee on the Evaluation of Engineering Education. The results of the joint inquiry will undoubtedly mark an important milestone in the future of professional education in engineering.

"Continued alertness of engineering educators and the engineering societies to meet the ever-expanding requirements of sound and adequate education for the engineering profession has been productive of substantial achievements," he continued. "But this very alertness and the lack of complacency which has happily characterized these groups, especially during the past half century, have created an awareness that the time is at hand for some serious soul searching to insure equal achievements for the future. There is a ferment at work which has had as its first product the initiation of the evaluation process.

"The real measure of the accomplishments in engineering education is in the contributions of its product to the profession of engineering. The recognition accorded that profession; the almost fantastic progress in industrial development and production conceived and managed by engineers; the great structures designed and built by them for the comfort, convenience, and health of our people; the increased number of great public and private enterprises directed by engineers, have been contemporary with the improvement in engineering education. . . .

"It is believed that the important conclusions from any objective appraisal of engineering education over the past century will indicate that its achievements have been real and significant; the changing requirements of the profession have been anticipated and met; those engaged in engineering education have been alert to needs required by circumstance and science; and finally, that as in any forward-moving profession, problems of change and adjustment are clamoring for solution in the new period of transition before us. These will be solved by the collaboration of all elements of the profession as other problems have been resolved in the past."

In the first two days at the Centennial it became apparent that engineering will, on one hand, move closer to science, and, on the other, closer to the people it serves. In a delightfully polished and at times whimsical address, "The Engineer and the Scientist," Dr. W. F. G. Swann said: "As more and more of the fruit of nature's richness becomes plucked, more and more of the potentialities of empiricism, founded upon the structure of matter in bulk, become exhausted, and the more do we have to look to the subgrained atomic and nuclear structure of matter for further progress. This necessity for an appeal to fundamentals has made itself obvious in electronics, where however, these subgrained matters have made their appearance with such subtlety that even the practical man has become inveigled into thinking in terms of them and to walking in a territory which would have filled him with fright if he had been thrown into it all at once. And now, the subgrained matters are invading other realms, the realms of metallurgy, where new things about the strength of materials, the nature of friction, etc., are only capable of being understood in terms of laws about atoms and molecules and laws involving ideas born of such relatively abstract things as the quantum theory of atomic structure. The time is coming when the engineer will find that the sharpening of his old tools is not sufficient for his task. He must acquire new and strange tools, tools which seem antagonistic to his common sense."

In his address, "Looking Ahead in Engineering Education," Dean S. C. Hollister of Cornell, cited a long list of problems essential to human life and continued progress, which will demand attention by engineers. Most of these arise out of the prodigality with which we have drawn upon natural resources and the increase in population—agriculture, water supply, timber, coal, natural gas. And there arises also the question of costs, which must be reduced by better engineering design.

"It is very clear," he said, "that we cannot delineate sharply the various techniques that will be in use 25 or 50 years from now, but it is certain that the principles on which these technical developments will be based are principles which are now available in the basic sciences. Our problem, then, is to strengthen the basic-science content of our curricula. The importance of this conclusion is emphasized when it is realized that the problems now before us are tougher to solve than the problems that have been before us heretofore, and require a more fundamental approach."

In commenting on an article in which an industrialist had rather complacently argued that our "natural resources were inexhaustible" and expressed the hope that many more deposits could be added if we could improve our methods of exploration, discovery, extraction, and processing, Dean Hollister said: "Apparently he did not readily recognize that the inexhaustibility that he was depending upon was largely the inexhaustible ingenuity of engineers. It is this inexhaustibility of engineering resource that concerns us in engineering education. We as educators must address ourselves more assiduously to the task of developing in our students their imaginative creative ability to a higher level than we have achieved in the past."

And so ended the second day at the Centennial.

ENGINEERING *in* MANAGEMENT

By J. G. PLEASANTS

VICE-PRESIDENT IN CHARGE OF MANUFACTURE, THE PROCTER & GAMBLE COMPANY, CINCINNATI, OHIO

PRESIDENT Harvey N. Davis of the Stevens Institute of Technology, in January, 1949, in a lecture at the University of Toronto, said that he gave the term "engineer" a broad, inclusive meaning, and that any graduate of a school of engineering remained an engineer, no matter what kind of activity the development of his career led him into. He went on to cite cases in which graduate engineers had become lawyers physicians, dentists, bankers, workers in sociology, ministers, and painters. He presented engineering not as a particular area of endeavor, but as a point of view.

Our professional literature gives plenty of empirical evidence that engineering is in management in a major way. As far back as 1947, the Engineers' Joint Council presented a pamphlet entitled, "The Engineering Profession in Transition," in which it was pointed out that, based on a 1946 survey, nearly 30 per cent of the professional engineers were engaged in technical administration and management.

The National Society of Professional Engineers, in its recent survey of 350 companies employing over two million people, reported that 92 per cent of these companies look for engineers for management, and that practically all of them have managers who are engineers.

An article in *Chemical Engineering News* recently reported on 100 chemical companies, to the effect that one fifth of the presidents were engineering graduates, that a slightly larger proportion of the operating executives had engineer's training, and that almost 27 per cent of the top executive promotions in 1951 were men who were engineering graduates. Of course, simple reasoning supports findings such as these. The most obvious reason for the need for engineers is found in the increasing technical complexity of our way of life. To hold the level of material civilization we have, and to maintain our going rate of progress in that regard, our industral and service activities simply require more engineers. If it may be assumed that the incidence of the personal qualities necessary to leadership is no lower among engineers than among other groups, then it follows that the more engineers there are in business, the more there will be at the top in business. That is self-evident.

GROWTH OF TECHNOLOGY

The business of my company, that of manufacturing soap and shortening, which a generation ago was probably thought of by most people as hardly technical at all, offers an example of the growth of technology. (After all, there couldn't be much to carrying out industrially a process which many housewives have done in their own kitchens and back yards.)

Twenty years ago we performed about two dozen different major processes in making our major products. In those twenty years we have added new processes or amended old ones, to the extent of 42 additions and changes.

Twenty years ago we used about 23 different types of raw materials—basic chemicals, processing chemicals, and additives. Today, the number has become 54.

Of upward of 1200 college graduates working in our manufacturing department, about 85 per cent are technically trained, and just under 20 per cent of these have advanced degrees. The rate of acceleration of technical activity in our business in recent years is brought out by the fact that 49 per cent of our technically trained people have joined us since 1947, and that figure steps up in the case of those with graduate degrees, to 57 per cent.

So even our relatively simple, erstwhile "kitchen" business, which in many respects had hardly changed at all in any basic way since before the Christian era, in recent years has been drawn increasingly into the whirl of technical progress, and consequently is more dependent on its engineers.

That this is so not only in our company, but in industry in general, of course is not news, nor is it surprising, because surely it is a fair statement to say that the wedding of engineering and management is in many respects a "natural." Engineers as a class are accustomed to being guided in their decisions and actions by facts, and rules based on facts. They are predisposed by training to reach out for experimental evidence which is reproducible and will be reported the same by every initiated and unbiased observer. They have, I believe, an inherent respect and desire for the "absolute truth," as contrasted with opinion, personal preference, hunch, and political or wishful thinking. The stability and honesty of engineers' standards when considered for application to the demands and responsibilities of management, make a most attractive picture against the background of today's confused political and international scene.

So we have arrived at these points:

That engineers are in management.

That we have to have them there to maintain our accustomed going rate of progress.

That engineers are, in an important way, especially qualified to be managers.

Granted these conclusions, suppose we, as engineers, try to make an appraisal of the present status of this job of management, in which we promise to play an increasing part, as we fit into it. Let's see if we can come up with a viewpoint of where we are and where we want to go. We may wind up asking more questions than we can answer, but at least we shall have tried.

MANAGEMENT'S JOB IS TO GUIDE, NOT DICTATE

It seems to me that engineers as a class are particularly qualified to recognize the fact that management of all kinds—industrial, governmental, civil—is properly a job of "guiding" people to the best of one's ability, in conformance with existing man-made laws and the continuing natural laws; as opposed to "controlling" people or "dictating" to them—a conception which in itself is practically sure to result in a violation of natural laws.

To me, there are two key points in this concept of management: (1) There is guidance, which implies the obligation on the part of those who are undertaking to manage, to lead others into an understanding of what it is all about; (2) there are the natural laws, concerning which engineers should have a special appreciation.

Engineers have a pretty good acquaintance with those gener-

Presented at the Joint Luncheon Meeting of the Management and Production Engineering Divisions, in connection with the Semi-Annual Meeting, Cincinnati, Ohio, June 15-19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

alized expressions of observable, reproducible natural phenomena which come out as the so-called laws of gravitation, of motion, of electromagnetism. With a little contemplation, it should be an easy step to the idea that Whoever established those laws also may have built in a few more laws concerning His most intricate creation—mankind—the violation of which may not be so immediately apparent, but is nevertheless out of step with the basic design of this universe. Let us give a minute or two to considering some possibilities.

Probably we shall never know for sure, but there would seem to be at least a reasonable possibility that this supply and demand business we hear so much about may have to do with a natural law—possibly with delayed action—which just can't be broken, however many government regulations are passed. It may be a natural law that mankind will look for a higher Being than itself to worship, and if that is the case, that yearning will never be controlled away—in Russia or anywhere else. It is even conceivable to my mind that there might be a natural law that has something to do with a man's wanting, even needing, to have a certain minimum amount to do with determining his own "security" in this world. If that is the case, then a manager—even in the government—who decides that it is his responsibility as a manager to wrap up the job all by himself may be stepping out of his class.

If I seem to be raising difficult philosophical questions, let's nevertheless face them: I am mainly trying to make the point that there is probably a dividing line here, for perceptive management, whether it is governmental or industrial, to recognize as marking the difference between what it can and what it cannot do. King Canute, by example, helped discourage management from trying to break the more obvious natural laws. There are probably other less obvious ones which still need to be recognized. I submit that engineers as a class should be as able as anyone else to recognize them.

ARE WE VICTIMS OF PROGRESS?

A corollary point which grows out of the foregoing consideration is that we are stuck with our progress, and management must face that fact. There may be week ends when, beset by parking or traffic problems, or by cowboy movies or commentators, we wish momentarily that automobiles, radios, and TV sets had never been invented, and we think back with longing to what we have heard of as "the good old days." But on further thought, it occurs to us to remember what the dentist was like before novocain, what pneumonia did to people before sulfa drugs, and how much of a plus things like deep freezers, disposal units, and air conditioning have been.

At that point we probably wind up deciding that we will not throw our influence on the side of turning back the clock. Actually, it is not for us to make the choice, for, to my mind, another one of those natural laws is involved: Enough people have enough of an "itch" for progress—enough people were just made that way—so that progress is going to continue.

So if our material improvement has had such side effects as concentrating people in the cities with the problems peculiar to that, and withholding from the production-line worker that satisfaction of personal craftsmanship which his grandfather had, and so stepping up the tempo of our living that nervous and mental disorders are on the increase, then management had best address itself to managing those side effects with a minimum of time spent in "viewing with alarm." It probably would be uncharitable to make too much of a point about the justice of engineers in management having to deal with problems for which the progressiveness and inventive genius of their profession carry so large a share of the responsibility.

STABILITY IN MANAGEMENT

In the face of this inevitable drive toward progress, I have a rather strong feeling, too, that it is important for management to exert some conscious effort to maintain a sense of humility—of proportion—to keep its feet pretty firmly on the ground. In the last half century or so of unparalleled technical advance, an incredibly lofty structure of material civilization has been built, and we seem to be continuing to build right on top of it—up and up. We have been moving along at a very fast rate. Based on our accomplishments to date, there seems indeed to be little to discourage us from straining our eyes for the first glimpse of the new and still more exciting landmarks which should come into sight; hence the justification for talk of such things as interplanetary expeditions.

However, as with any trip, during this fast ride that we have had, we have been dependent on certain motive power. The amazing, exhaustless creative power of the minds of men and their constructive co-operation have brought us this far. Should this motive power fail us seriously in execution, or in the direction toward which it moves us, our future could begin to look very different. Inconceivable, someone may say! Perhaps so, but who among the engineers wants to be careless enough to take that for granted?

When we have problems to solve, certain things are always "given," and the solution of the problems goes on from there. The accuracy of the answer is entirely dependent on the accurate fixation of the given conditions. In the same way, management decisions always go forward from some foundation of assumptions, which is taken to be dependable. My point is that the very wisest management among managements probably will do well to divert enough of its attention from the work which is proceeding on the top floor of this dizzy technical structure we have built to keep a careful eye on the foundations, the fundamentals, the taken-for-granted assumptions. They can stand inspection, reinspection, and from time to time, may need some shoring-up.

I know it sounds pretty sensational, but I can't help thinking what an inglorious interruption to our progress could occur if something slipped badly in connection with the H-bomb or with our international relations, and the scorched survivors had to resort for a time to concentrating the hard way on the old fundamentals of food, warmth, and shelter.

MANAGEMENT'S OBJECTIVE

For my last point in this effort to appraise just what engineers should be thinking about as they enter increasingly into management, I arrive at something which is intermediate among the others we have discussed; yet it is distinct enough to merit special comment. In coping with its obligations to plan and guide, to realize that progress is inevitable, and to retain a proper proportion of humility, management must develop a clear perception for end objectives that are worth-while and basic. It must guard constantly against being stampeded by the pace we are traveling, or confused by temporary side effects. It must be alert to recognize the distinction between the ends, and the means to those ends.

In this territory we find it easiest to ask questions, and most difficult to answer them. An authoritative definition of our ultimate principal end objective in this existence—one which everyone could understand and accept—would be a most comforting and simplifying thing to have. I suppose that the consensus would still be that our closest approach to such a guide is to be found in the various religions. These, of course, vary from segment to segment of the world's population, but I have yet to hear anyone declare that for this purpose anything superior to them is to be found in any of our technical texts or handbooks. And somehow, I have an idea that when

the time comes in which we know all the answers, it will turn out to be more important how people have lived, worked, got along together, than how high the WAC corporal flew, or what the underwater range of the first atomic-powered submarine may be.

Many voices and much publicity these days are beating high-pressure "musts" into the ears of all of us, including management, whose duty it is to initiate desirable action. Much of this pressure is most persuasive, plausible, verifiable as to facts and figures, and in some cases even emotionally appealing. Yet in the face of it all, my thesis, it seems to me, is still sound; that management must not be stampeded, but must judge each suggested course of action carefully, as to its order of importance, and as to the end to which ultimately it will direct us.

For example: We are told that the supply of engineers is going through a low point in relation to the demand, that we are short approximately four years' worth of graduates against the current needs of industry and government. Accepting the needs as they are presented today, for whatever reasons, that is undoubtedly true. Something is being done about it, at least to the extent of swarms of interviewers on the campuses, and the rising salaries that are being offered. Yet, if management is looking for something to be concerned about and give its attention to, I believe at this point it should ask itself this question: Is the shortage of graduating engineers of the first order of importance, or only second or third?

Granting that we are short engineers, and that the development of the next synthetic fibers and perhaps the generation of atomic power for industrial use may be delayed three or four years as a consequence, is that sort of problem as important to our future as, for example, the resolution of the question of whether or not the union shop should be compulsory?

We have heard of a program under which management in this country is asked to help in educating visiting teams of industrial managers from other lands in how we do it. I would not talk against this program; but I would suggest that management ask itself some questions about "proper proportion" when it is considering how much time and effort such a program should be allotted. Is it deserving of as much consideration as, for example, an educational campaign to correct a certain officially sponsored and legalized concept? I am referring to the concept that in this country management and labor must compete against each other. I am referring to the much greater relative importance of advancing public appreciation of the fact that workers and employers are on the same team and that, in proportion to their mutual respect and co-operation, every citizen of this country will prosper increasingly.

So much of what we are somehow brought to believe we must or should do these days follows the hypothesis that this or that national objective is necessary in order to assure our proper security in this world of today. That is a very easy thing to talk for, and difficult to talk against, and I do not propose to talk against it. But the program of forming alliances with our sometime friends, of equipping them to some extent out of our pockets to defend themselves, of educating backward areas of the world how to live better under our system—all of this is not an end in itself. It is only a means to the intermediate end of extending the political and economic climate which we find favorable, putting a bulwark around our way of life and way of government. But if, in pursuing this program, we accept measures which in the end destroy the very way of life we started out trying to protect, then we have indeed put the cart before the horse, and have participated in some very tragic irony.

These examples emphasize the point that management should not let itself be stampeded by popular slogans, programs, movements. It must set the example, and inspire others to follow suit, in searching for the real end objectives that we need, and then in pursuing them thoughtfully and deliberately. That may well mean that somewhat more of management's time and energy must be put into educating our fellow citizens, and into the practicing of our government processes as they were meant to be—by the people. If these contributions by management result in some sacrifice to the velocity of our material and economic progress, then so be it.

Mr. Lemuel Boulware of the General Electric Company recently touched on this responsibility when he discussed the obligation of engineers, both in and out of management, to use their good minds in taking the initiative in the economic and political education of others.[1]

MANAGEMENT SHOULD UNDERSTAND PEOPLE

Some of the questions I have raised and comparisons I have made may imply criticism of the situation in which we find ourselves today. That is a legitimate conclusion, and I shall let it stand; but no disparagement is intended. I do not pretend to have the ability to blueprint the answers to all of these different questions. What I should like most of all to see is for us to keep what we have honestly and fairly won, materially, and to add to it; but to supplement our skill in that field with whatever other skills we need, to enable us to assimilate and utilize our technical progress gracefully and properly.

For management, this kind of objective poses many questions which I would be the first to declare difficult of solution; but it seems rather plain that, for the engineer, an indispensable first step in the right direction will be found in increased emphasis on the understanding of people and of communication among them.

Mr. Clarence Randall, in the third of his series of twelve articles, "Creed for Free Enterprise," recently appearing in the *Cincinnati Enquirer*, was quite outspoken on this subject of "understanding of people" in these lines: "Leadership, like everything else in life that is vital, finds its source in understanding. To be worthy of management responsibility today, a man must have insight into the human heart, for unless he has an awareness of human problems, a sensitivity toward the hopes and aspirations of those whom he supervises, and a capacity for analysis of the emotional forces which motivate their conduct, the projects entrusted to him will not get ahead, no matter how often wages are raised.

"Unhappily this has not been our long suit so far. We have done far better with machines than with people. The all but supernatural advance that we have made in technology, and the vast physical expansion of plant that we have brought about, have not been matched by wisdom in the behavior of one man toward another, or of a gang toward the leader. To a certain degree, I am afraid that this is the result of the extent to which American industry during the past generation has been dominated by the engineer and the chemist. I say this not critically. Being neither myself, I have a respect bordering upon awe for what the research and engineering geniuses have done to improve our processes and products, but what I am talking about is management emphasis."

Regardless of whether or not we agree with Mr. Randall's fears concerning the effect of the increased presence of engineers and chemists in management, the point of view which he has expressed in this respect should give us all food for thought. I think we may fairly point out that there is a positive as well as a negative side to this question. To me it seems as though the positive values which result from the application to a

[1] "Good Engineer—But Good Citizen Too," by Lemuel Boulware, *General Electric Review*, May, 1952.

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TECHNOLOGY *in a* TROUBLED WORLD

By WILLIAM C. FOSTER

DEPUTY SECRETARY OF DEFENSE, WASHINGTON, D. C. MEMBER ASME

NO one will challenge the statement that we live in a troubled world. Our nation is in an emergency—an emergency devoted to preventing all-out war, or to winning such a war if it is forced upon us. This is a period which requires as much selfless and devoted effort as any military conflict in our history.

One of the greatest needs of our times is a full realization by the American people of the true nature of this emergency, unaccompanied by hysteria, subjected to nonpartisan discussion and careful analysis, and met by the development of a steady long-term policy to challenge the threats which confront us. The problems that we face have no easy or quick solution. These problems are strange to many of us who grew up at a time when the power politics of the Old World seemed a wicked phenomenon in distant places of only minor concern to us of the "Brave New World."

Unfortunately, times have changed and technology, perhaps more than anything else, seems largely responsible for this change. The conquest of space with long-range aircraft has removed the protection with which geography endowed our country. The development of weapons with a destructive force undreamed of 15 years ago exposes our cities and those of all other countries to unprecedented dangers. These two factors alone would be sufficient to require a basic change in our policy. In addition, a world which only 15 years ago contained seven great powers, which could balance and check each other, is today largely divided under the leadership of two great powers, the United States and Soviet Russia, with the latter devoted to the promotion of world revolution. These developments, whether we like it or not, have thrust upon us responsibilities which former generations could safely ignore. Failure in this tremendous task will endanger everything we value as individuals and citizens and mankind might never recover.

The stakes involved in the present struggle with Communism are of such magnitude that no American can afford the luxury of narrow personal goals at the expense of service to the community. It seems to me that no engineer can afford to ignore the pleas of Dr. Wright to our profession to assume increased civic responsibilities.

The answer to the question which Dr. Wright raised in an article "Is the Engineer a Lone Wolf?" must be in the negative. In this article, which carried the subtitle "More Explicitly, Is the Engineer a Slacker in the Discharge of His Civic Responsibilities?" he referred to indifference being the cancer that destroys democracy and concluded with a quotation from Hendrik Van Loon:

"For alas, none of the leaders seems as yet to have learned that democracy, being the most difficult and complicated form of government ever devised by human ingenuity, can be maintained only by constant watchfulness on the part of all the citizens and by a most careful scrutiny and selection of those whom they wish to recognize as their leaders. Without that unselfish devotion to the interest of the community at large, all democracies are bound to end in a dictatorship."

I do not intend in any way to imply that the United States is in that situation, but intelligent participation by citizens in the affairs of government remains today—more than ever before—a basic requirement for the survival of democracy in this troubled world. To this task, engineers can perhaps contribute more than any other group because of the importance of their profession in a technological era.

URGENT NEED FOR ENGINEERS

One indelible impression of my work in the Government has been the urgent need for engineering skills and discipline which I have encountered in almost every phase of our national problems. More engineers are required to maintain the dynamic economy which made us a great power. More engineers are required on a multitude of projects sponsored by the Armed Forces for our national security. Underdeveloped countries abroad await the arrival of technicians who alone can reduce the existing poverty which makes the local population vulnerable to Communist double-talk.

In the machinery of our own Government, engineers trained to assemble the essential facts, draw the correct conclusions, and arrive at logical solutions, can make invaluable contributions for the common good at all levels. I doubt that engineers as a group ever before faced as great a challenge or carried as heavy a responsibility.

The requirement for more and more engineers in the United States—especially engineers with a broad approach—constitutes one of the most important problems of our national security requiring an urgent solution. Looking at our past achievements with justified pride, we have taken our engineering ability for granted and assume that the leadership which we have exercised in this field for so many years will remain unchallenged. This is not a time for selfish satisfaction.

It is estimated that Soviet Russia graduated almost as many students from technological schools in 1952 as the United States. The atomic explosion in the Soviet Union, announced by the President in September, 1949, speaks for itself. The mass production of jet fighters of good quality and the radar tracking equipment used by Communists in Korea furnish additional evidence that it would be dangerous to underestimate the engineering capabilities of the Soviet Union. In order to keep our leadership we must constantly forge forward and continue to encourage our most capable young men to choose engineering as their profession.

The second major requirement which I mentioned dealt with participation of engineers in the numerous projects sponsored by the Armed Forces for our national security. I am fully aware of the sacrifices in time and effort that many individuals and companies are making in the national interest, especially when, if left alone, they probably would prefer to

Roy V. Wright Lecture, presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15-19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

work along less disturbing and more familiar lines. However, these sacrifices are essential to survival, for armed strength by itself is not sufficient to guarantee the security of our country.

National security in the present age requires the close integration of scientific and technological resources for the common purpose. The degree of this integration will vary with the intensity of the threat that faces us, but the civilian resources which by conversion or redirection will constitute our main support in time of war must be associated closely with the activities of Government in these times devoted to preventing such a war from happening.

Our Armed Forces became fully aware during the last war of the great contributions that engineers, scientists, and businessmen can make to victory. These partners of the military forces provided techniques and weapons which enabled us to outwit and overwhelm the enemy. Their understanding of the needs of the Armed Forces made possible the highest degree of cooperation between civilian and military. We in the Defense Department are attempting to draw into our planning for national security all civilian resources which can contribute to the defense of our country. Success depends upon the cooperation with which the nation as a whole and each profession is willing to respond.

ENGINEERING CONTRIBUTIONS TO DEFENSE

The importance of this work is perhaps best illustrated by the outstanding role played by engineers and scientists in the Manhattan Project and the development of the atomic bomb. This experience overshadowed the many other contributions made in developing weapons and materiel for our Armed Forces on the land, the sea, and in the air, and the thousand and one contributions which made it possible for our factories to produce the necessary equipment in quantity and on time.

Today more than 50 per cent of our scientists are engaged in defense work, part time or full time. One may regret that this has to be, but it reflects the crucial importance of their work in our national security effort. The contribution of engineers is no less important but our records do not indicate in my opinion a sufficient proportion of our engineer resources being directed presently to the same end.

Our supply of engineers and scientific manpower is a limited one and it can be expanded only slowly. There exists what we in the Department of Defense call a long "lead time" in the production of trained engineers and scientists. Thus, in the critical period ahead, any effective increase in the availability of engineering and scientific skills must come from better utilization of our existing resources in industry as well as in Government.

The Department of Defense is deeply aware of its responsibility in this field. Recently we made a study of all the physicists, chemists, and related scientists on active duty with the Armed Forces and found that there were only 815 of these. This is a very small number, but, what is even more significant, our study revealed that only 31 of these 815, or 3.8 per cent, were improperly assigned and steps were initiated immediately to correct these cases. A 1951 government survey revealed that only about 2 per cent of all graduate chemists and physicists were in the Armed Forces.

These statistics clearly show that the Army, Navy, and Air Force have not hoarded a disproportionate share of technical and specialized personnel, and that no widespread malutilization of such personnel exists in the Armed Services today.

INDUSTRY CAN USE ENGINEERS MORE EFFICIENTLY

The major challenge for improving the use of our limited engineering and scientific manpower seems to lie with private industry. Recent reports indicate that the Federal Government employs only 14 per cent of all the electrical, mechanical, and chemical engineers in the country. State governments employ 10 per cent, and local governments 6 per cent. All the rest are in the civilian economy.

One of the leading employers of engineers recently asked: "How many engineers are hunched over a drafting board on mechanical work? How many are compiling statistics and drawing graphs? How many are playing nurse to ailing machines? How many are caught in blind alleys doing specialized work that requires no particular talent? In other words, do we have an actual shortage of engineers or does it just look that way because of the manner in which we have put engineers to work?"

These questions represent one of the major challenges of the present day. Those who are responsible for employing and managing engineers and technical personnel can make a vital contribution to our national security in this field.

OPPORTUNITIES IN UNDERDEVELOPED COUNTRIES

The third major area of opportunity for engineers in our national security effort lies abroad, especially in underdeveloped countries. As Administrator for Economic Co-Operation, before joining the Department of Defense, I worked to help the economic recovery of Europe as well as to promote economic stability in many of the countries of the Near and Middle East, southeast Asia, and the Far East. In most of these countries there existed a need for American goods, but even more important was the requirement for our technological knowledge which could help meet the urgent need for increased industrial and agricultural productivity.

Much of the distress and difficulty abroad is caused by the simple fact that people do not have enough to eat or wear. Half the world averages less than $100 per capita per annum. A Chinese statesman once said to a friend of mine that the difference between his country and ours was that in China a man had to work 12 to 15 hours a day to produce enough so that he could eat and have some clothes on his back.

We in the United States, with a much higher standard for minimum needs, can achieve the same with an average work day of 5 to 6 hours. Our continued progress as a nation depends to a large degree on the wise use we make of this additional time at our disposal. In the present world situation a greater and greater share of this time must be devoted to teaching less privileged nations some of the techniques which have contributed so greatly to our own progress.

The ASME has not ignored its opportunities in this direction. It was my privilege while in the Economic Co-Operation Administration, to award the Society a certificate of co-operation for assisting foreign engineers to study American engineering practices. This work is continuing but we need more of this unselfish spirit which supports our efforts to establish a true partnership with those who are or who wish to be our friends. It is in our long and short-term interest to develop to the greatest possible extent mutual strength and stability throughout the world.

Stability will come through better economic conditions which many of these countries can attain only by our sharing with them our technological knowledge and by assisting them to develop better governmental procedures which insure that the new fruits of productivity are equitably shared by those who produce, those who own and manage, and those who consume. Many of the worst difficulties in the past have come about as a result of violent and hostile contact between peoples. We must work out a way in which those contacts can be made friendly and constructive.

CREATING STABILITY IN THE FREE WORLD

This international effort is a two-way street. Many of the countries which we assist are also the source of critical raw materials without which our own economy would soon slow down. By making these countries stronger and better we assure a more dependable and larger flow of materials the lack of which today is limiting our own production. At the same time we are promoting by this effort the development of potential allies in the defense of the values which the free world shares.

This task does not involve exorbitant expenditures and does not require—as some people are inclined to imply—that the United States carry the entire burden of the rest of the free world on its own shoulders. On the contrary, it is a task in which we help others to help themselves—a task in which we carefully select the areas where our help can produce maximum results on a minimum investment—a task in which engineers have real opportunities to make invaluable contributions to their nation's security.

Any increase in the production of these countries makes it possible for them to assign an increased percentage of their national income to the development of their armed forces for defense against aggression from without and subversion from within. The history of the postwar years has clearly demonstrated that Communists move in where weakness exists, and the development of economic strength is the inevitable prerequisite for the growth of national strength. Engineers who engage in this world-wide enterprise will find the rewards great—perhaps not in a monetary sense, but in terms of service and accomplishment in a cause vital to their country's safety. It is a long-term task in which opportunities for service will continue to exist for many years to come.

THE ENGINEER AS A PUBLIC SERVANT

My final plea deals with the engineer as a public servant. It is a field into which I have been thrown by strange circumstance and one which Dr. Wright considered of basic importance to the engineering profession. I fully agree with the enthusiasm with which he carried on his mission of inspiring young engineers to go into community activity. I strongly believe that there is a great need for people trained as engineers to join with the many lawyers, economists, accountants, and statisticians in contributing to our domestic and international responsibilities the benefit of professionally sound thinking.

The reward for such contributions lies, to a considerable extent, in the varied associations made in this work, the training in human relations, and the growth of understanding that develops from experience in other fields. No matter how good one's education, no matter how good one's technical training, it is my deep belief that, in order to develop a well-rounded human being, a good measure of community activity is essential. Engineering, in my opinion, should be the means to a fuller life, not the narrow goal.

Because the engineer works basically with physical things, he often has been charged with a lack of human understanding. It has been said that he has little appreciation of the spiritual values in life, that he is impersonal and unemotional and even indifferent to the political and social world around him. There may have been some truth to these allegations in the past, but they are rapidly becoming less valid. In my day, the curriculum in engineering colleges gave little attention to the humanities. Today, our engineering schools have become convinced that a purely technical education is not enough. They have widened the curriculum in order that, trained in psychology and government as well as in the skills of his profession, the engineer may accomplish broader missions. This is a sound development and should produce increased benefits in the future.

THE TEST OF SERVICE

First, a word of warning. I do not hold that an engineer can be of outstanding usefulness in the field of government simply because he is an engineer. The bestowal of a degree in engineering does not suddenly endow the candidate with qualifications that he did not possess a few moments earlier. The engineer receives rigid training in his profession, but his real value as an engineer depends on what he makes of the opportunities he encounters in later life. This test he shares with the professional soldier. With the expansion of our Armed Forces in World War II many officers of junior rank were thrown into positions of high responsibility. Some of them grew up with their new responsibilities, but others found it impossible to rise above their own limitations and remained of junior rank at heart. A similar danger faces the engineer.

It will be recalled that Dr. Wright pointed out the fact that education was important, but much more important was experience in the art of dealing with people, especially in the activities of government, starting with first principles in the ward, the village, the city, and thus ultimately the state and the nation. I want to re-emphasize the need for experience in the more elementary stages in government in order to enable individuals to make contributions of service on a higher level in a later stage.

Participation in community affairs by young engineers, either in their engineering schools or in the communities where they take their early jobs, may be equally as important as the formal training they received in the classroom. I know from personal experience that time spent in community activities pays great dividends to the individual as well as great dividends to his city, state, and nation.

It is not easy to devote one's spare hours to learning a game seemingly not allied to one's profession, but a man in school who is active in such things as student government, class management, publications, debating societies, team athletics, social and church work, or one who after leaving school enters the work of service clubs, chambers of commerce, town clubs, athletic clubs, welfare societies, citizen committes of one kind or another, attends meetings of the town council, county boards, and what have you, will find that, almost unawares, he has increased his capacity as an engineer and a citizen. He now can bring to his work the advantages of his engineering training plus the ability to discuss and formulate policy and lead others to the agreed-upon goals.

Such outside activities by our best-trained engineers, begun early in their careers, are more vital today than ever before. In view of the rate at which new problems arise in this present troubled world of ours, we must develop more and more young men with leadership capability if we are to retain our present eminent position in the world. Having had the task of world responsibility thrust upon us, even against our will, it is impossible for us to relinquish our leadership except at the price of the destruction of our nation and all we hold dear in the world. The pages of history are replete with evidence showing that the days of a nation are numbered when leadership at the top becomes thin and weak or when no sound method exists of maintaining a continuous supply of new leadership material from lower to higher ranks.

We have been fortunate as a nation in not losing, like Great Britain and France, the best of our youth on the battlefield. While our losses were heavy and have been added to by Korea, we still have a large reservoir of capable young men from which

(*Continued on page 796*)

PLYWOOD *Is* ENGINEERED WOOD

By THOMAS D. PERRY

ENGINEER IN WOODWORK, MOORESTOWN, N. J. FELLOW ASME

WOOD, the solid part of a tree, has served mankind for untold centuries, from the primitive club or weapon of prehistoric man, through a multitude of useful applications, to the grand piano of today, to name only one of many interesting developments in wood that man has perfected.

From antiquity to the present time, the workability of wood has made it a prized material for conversion into wood products, adapted to the necessities and comforts of living. Among them may be cited: fires for warmth; houses for shelter; shops for work; furniture for relaxation; skis and rackets for sports; wood carvings and musical instruments for the gratification of aesthetic tastes; as well as for other innumerable and familiar purposes.

While the one hundred years under consideration, 1850 to 1950, may represent an era in engineering, as the profession is recognized today, it is a relatively short period in comparison with the many centuries of wood utilization. Most of us who have passed the three-score milepost, are descended from parents who were born not far from 1850. We have listened to the stories of our mothers and fathers, as well as of our grandparents, telling of the rigorous and simpler living of one hundred years ago. We can picture more or less vividly the homes and home equipment of the 1850's. Products of wood were there aplenty, but they were of solid wood, made with painstaking care from air-dried lumber. Wide boards were prized and occasional joints, made with animal glues, were viewed with considerable apprehension. Warping and splitting were regarded as inevitable.

EARLY MACHINE DEVELOPMENTS

A glance backward will indicate that two Englishmen, Sir Samuel and one Jeremy Bentham, were responsible for extensive developments in woodworking machinery about 1800. Their objective was to train prisoners under their charge to do accurate machine woodwork, since they appeared to be unable or unwilling to acquire the skills of hand woodworking, the only trade practiced in the prisons of that time. To what extent these pioneer machines aided in the training of prisoners is unknown, but it is certain that the Bentham patents represented important mechanical advances, and were the background for many early woodworking machines. These soon appeared in English, as well as in American cabinet shops. Among the many patent claims of the Benthams was the idea of a large power planer or shaving machine, designed to cut thin slices of wood. This idea was supplemented by some suggestions for laminated constructions. There is no evidence, however, that this planer found much favor, nor that laminating methods were encouraged thereby.

A primitive rotary lathe, Fig. 1, for cutting thin sheets of wood, then called scales or scale boards, was patented by an American, John Dresser, in 1840, but apparently it was quite unimportant in the woodworking of that era. That was before anyone dared to visualize the possibilities of plywood construction, as it is known today.

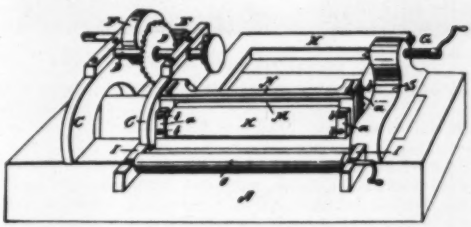

FIG. 1 EARLY VENEER LATHE

(From U. S. Patent No. 1758, September 3, 1840, to John Dresser. Note hand cranks provided for operation.)

WHAT IS PLYWOOD?

Plywood is an assembly of thin layers of wood, in which the alternate layers are arranged crosswise, the whole being firmly glued together. This is a basic description, quite inadequate from the viewpoint of today, but this definition will be supplemented by other useful qualities as they are shown to have evolved through the years. A summary of the principal characteristics of modern plywood, as they have been developed in this one hundred years, will follow logically, near the end of this paper.

Plywood, either as a wood product or as a name of a wood product, was practically unknown in the 1850 period. Such combinations of wood layers were not recognized as a possible panacea for the normal limitations of solid wood. The thin sheets of wood, which we now call veneer, and which were needed for the layers of plywood, could be made only by hand, and the small supply available was irregularly cut and very costly. At the time there was no encouragement toward developing better wood combinations of the plywood type.

EARLY EVIDENCE OF PLYWOOD

There were a few forerunners of plywood before 1850, the outstanding being the pin block, or wrest plank, in a piano, made about 1830, of several crossed layers of thin-sawed maple lumber, glued into a rigid block. The tuning pins, to maintain wire tension, were set in slanting rows in these pin blocks, Fig. 2, some 40 in. × 8 in. × $1\frac{1}{4}$ in. in size. Experience indicated that metal tuning pins with grooved or spiral shanks, would hold their grip indefinitely in such cross-laid and glued wood constructions, far better than in metal plates or in solid wood blocks. It was of prime importance that such tuning pins stay put, and it was equally necessary that they be tightened or loosened, easily, in tuning the piano. While the term plywood did not come into use until about 1916–1918, these pin blocks were true plywood constructions, since they exhibited

Contributed by the Wood Industries Division and presented at the Fall Meeting, Chicago, Ill., September 8–11, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

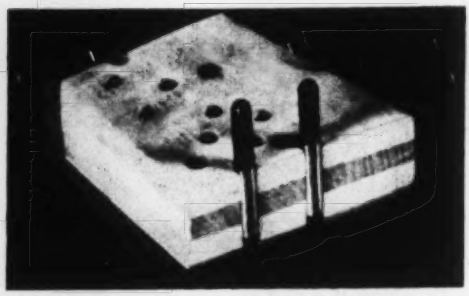

FIG. 2 MODERN PIN BLOCK AND TUNING PINS
(Plywood made of cross-laid sawed maple. Courtesy Steinway.)

dimensional stability. They have been standard construction for all pianos ever since.

A much earlier use of wood veneer dates from the dynasties of the Pharaohs in Egypt, more than 3000 years ago, when thin sheets of decorative species were shaved, or split off, and glued to other blocks of wood, which served as a nondecorative but sturdy base for these fragile veneers. It was not plywood, as the term is understood today, since there were no balancing cross layers. These early veneered constructions lacked the more important characteristics that plywood now imparts to wood products: such as distributed strength; resistance to splitting; and reduction to a minimum of tendencies to shrink, swell, and warp. Nevertheless, it was a practical, if somewhat primitive, method of displaying the beauty and attractiveness of wood, which is one of the functions of plywood.

ONE HUNDRED YEARS IN RETROSPECT

The title of this paper, "Plywood Is Engineered Wood," indicates that plywood has gradually evolved as the result of the application of engineering principles to wood fabrication. Woodworking shops, in the earlier decades, were relatively small units engaged in a highly competitive struggle for survival and there was little incentive, time, or money for experiments, no matter how promising they might be. Few owners of woodworking shops dared to venture away from traditional paths and into new and unexplored methods. Woodworkers have been, and still are, singularly conservative, but nevertheless they have shown a background of ingenuity which has kept progressive developments alive and has gradually evolved the techniques that have made plywood the outstanding product that it is today.

Perhaps a division of this one hundred years into five periods of twenty years each, will afford the clearest perspective of how plywood has grown in importance and acceptability until, in fact, it is now a major division of the forest-products industry, which in turn is one of the six largest branches of all manufacturing in the United States.

In brief, these twenty-year periods may be characterized as follows:

1850–1870 Primitive plywood developments.
1870–1890 Intensive development and general recognition of plywood.
1890–1910 Plywood becomes standard procedure in furniture.
1910–1930 Structural plywood makes a strong start, and water-resistant glues become important.
1930–1950 Improved waterproof adhesives, hot-pressing, and omnidirectional pressure broaden the plywood field.

PLYWOOD IN 1850 TO 1870

These two decades were characterized by intense political controversy over secession, leading to the Civil War in 1861, as well as by the opening of the West to settlement, culminating in the transcontinental railroad in 1869. While there was, undoubtedly, some incidental progress in civilian industries, major attention had to be directed to military supplies and to the establishment of pioneer industries in the Midwest and Far West. It was in no sense a period of intensive development and improvement within any particular industry.

In spite of this concentration on preserving the Union and on westward migration, there were signs of progress in plywood. The grand piano made its start and its gracefully shaped rim, Fig. 3, could be made only by curving an assembly of thin and somewhat flexible layers of wood, to be held in shape by a strong glue. While not strictly a plywood construction, since there were no cross layers, it demonstrated one of the features of plywood, that of gluing a complicated curved form into a rigid whole. The Steinway Company is credited with the development of this curved laminated rim, probably in the early 1850's. The veneers were sawed, not shaved, and makers of quality pianos still prefer sawed veneers for rims.

Another plywood activity, late in this period, was undertaken by the Sewing Machine Cabinet Company, started in Indianapolis by Wheeler & Wilson in 1867. By this time veneer slicers had been developed, and the cost of making thin veneers had been reduced substantially below that of sawed or shaved veneer. Accuracy in thickness, not before attainable, made it far more practical to assemble them into plywood. The sewing machine of that day had a curved lid, or cover, Fig. 4, which was used alternatively as a convenient, if somewhat uncomfortable, seat for the operator. Many old-timers can remember them in the ancestral family home. With the practical development of the veneer lathe, probably around 1870, the cost of veneer was again reduced enough to justify its use as a cross or balancing layer.

It is believed that John K. Mayo, in 1865 and 1868, took out the first significant patents in the plywood field. These still refer to thin sheets of wood as scale boards, and nowhere mention veneer, which apparently was a term reserved for thin sheets of choice species employed for decorative purposes, perhaps in contrast with scales for utilitarian applications. A quotation may be illuminating:

"The invention consists in cementing or otherwise fastening

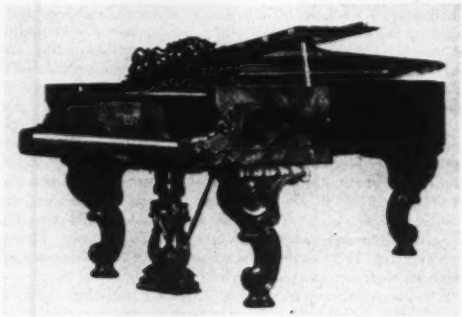

FIG. 3 STEINWAY PIANO OF 1857, WITH CURVED LAMINATED RIM OF SAWED VENEER
(Reconditioned by its makers in 1918. Fancy rosewood veneer has no underlying cross-band veneer.)

THE
Sewing Machine News
AN INDEPENDENT, ILLUSTRATED MONTHLY TRADE JOURNAL.
Vol. VIII. NEW YORK, FEBRUARY, 1885. No. 2.
OUR NAME IS OUR MOTTO.
STANDARD
SIMPLE
SMOOTH.
THE POETRY OF MOTION.
SOME of the best Sewing Machine m
have been in the business all their
and will not handle an inferior a
"Standard" inspires confidence where no
STEEL ATTACHMENTS
BEAUTIFUL TO LOOK UPON.
GENUINE IMPROVED
Bent Woodwork,
WOODEN SHELVES
Forming Covers to the Drawers underneath.
FINEST WOODWORK IN THE WORLD
THE "STANDARD"
E. F. FRENCH,

FIG. 4 EARLY SEWING MACHINE (1885) COVER WITH ROUNDED PLYWOOD TOP
(Note curved drawer ends and elaborate plywood overlays on sides of cover and drawers. Courtesy Smithsonian Institution.)

together a number of these scales or sheets, with the grain of the successive pieces, or some of them, running crosswise, or diversely from that of the others. The crossing or diversification of the direction of the grain is of great importance to impart strength and tenacity to the material, protect it against splitting, and at the same time preserve it from liability to expansion or contraction."

PLYWOOD IN 1870 TO 1890

The lag in the normal growth of plywood, which had occurred in the 1860's was more than made up in the 1870's, when industrial development shifted into high gear. Another important plywood patent was granted in 1872 to William Gardner, and there seems to have been considerable patent controversy in the years immediately following, with many records of assignments, licenses, infringements, and litigation, all indicative of an intense interest in plywood developments.

In a catalog of Gardner & Company, New York City, about 1875, there are many illustrations of perforated and curved plywood settees, benches, and other types of seating, which obviously were the result of several earlier years of development. They were popular for lodge rooms churches, passenger stations, ferry boats, and public auditoriums. The perforations were often fashioned into geometric designs, mottoes, emblems, seals, and even symbolic figures, Fig. 5. It must have required a deal of patience and time to bore such a multitude of holes, before gang drills were developed! Some years ago the writer happened to be in a small and dingy railroad station in Ohio, and noticed perforated plywood seating, reading "Pennsylvania & Ohio R. R.," which seating had withstood hard service for some fifty years, and was still as sound as when originally installed. The name and identity of this railroad had long since been absorbed in mergers, while the plywood seating had resisted the ravages of time. This might be an argument that plywood is more enduring than certain railroads!

This plywood seating required large areas of veneers. There was, inevitably, a considerable accumulation of small pieces, before the development of methods to splice them together into larger and usable pieces. Consequently the perforated plywood chair seat came into being, slightly dished for sitting comfort. This item is still, after some seventy-five years, available in many stores, although the holes are gang-punched, rather than bored. This seating was plywood in every sense of the word, usually 3-ply, $^3/_{16}$ in. or $^1/_4$ in. thick, and was curved between rigid forms as it was glued.

The Indianapolis Cabinet Company, successors to the Sewing Machine Cabinet Company, mentioned previously, continued the sewing-machine business, but also branched out into making

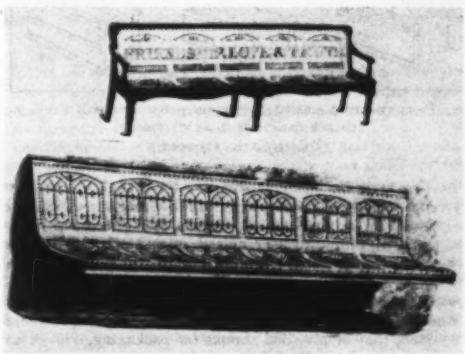

FIG. 5 PERFORATED PLYWOOD SEATING FROM CATALOG OF GARDNER & COMPANY, DATED 1875

plywood for cabinet organs, including bellows, ends, and fretwork. Shortly after 1880 this company started making thin plywood for furniture, to be set in frames, and used for case ends, for bed ends, for drawer bottoms, and for general cabinet work. In about 1883 a new and different type of plywood was developed, that of plywood tops for office desks in 5-ply constructions with lumber cores, Fig. 6, the first example of other than all-veneer constructions.

By 1883–1885 the use of plywood in furniture had become of distinct importance, and furniture plywood, made to customer requirements, was in production in newly established plywood factories, in Louisville, Sheboygan, Grand Rapids, Newport (Vermont), Two Rivers (Wisconsin) and other points.

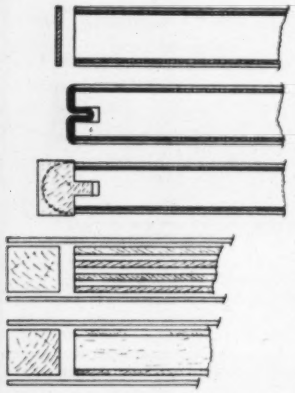

FIG. 6 CROSS SECTION OF MODERN PLYWOOD DESK TOPS, SHOWING TYPES OF REINFORCED EDGES

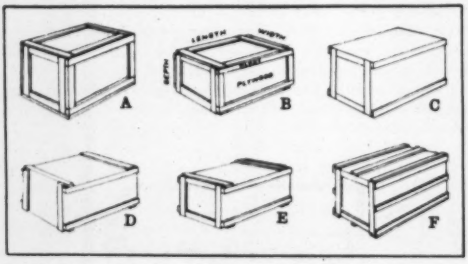

FIG. 7 PLYWOOD PACKING CASES, SHOWING VARIOUS TYPES OF LUMBER CLEATS USED AS STIFFENERS
(Courtesy Atlas Plywood.)

At this stage furniture factories did not make their own plywood. Plywood factories were fully integrated, cutting their own veneer, gluing it up, and delivering it to the furniture maker according to his requirements. Native hardwoods from nearby forest areas were utilized—birch, poplar, maple, basswood, and elm, with decorative face veneers, such as mahogany, walnut, and oak, which were purchased.

Another branch of plywood utilization was developed about 1885–1888, that of plywood shooks for packaging, Fig. 7, an activity believed to have been started by the St. Louis Basket & Box Company, as an adjunct to making single-ply veneers for baskets, berry boxes, and fruit containers.

PLYWOOD IN 1890 TO 1910

The decade of 1890–1900 marked the rapid expansion of plywood in furniture. A number of new plywood factories sprang up in Jamestown (N. Y.), Portsmouth (Ohio), Algoma, Wausau, Marshfield, northern New England, and elsewhere. The 5-ply construction with lumber core, originally developed for large desk tops, about 1883, proved to be very desirable for a wide line of tops for furniture and case goods, for bed ends, and for drawer fronts. The lumber core provided a sturdy and durable base for fragile face veneers, matched in a large variety of designs to reveal and display the inherent attractiveness of wood veneers. While a few of these matched effects could be obtained in solid wood, the inevitable shrinking and swelling soon detracted from their beauty. A selected 4/4 board of intricate and interesting grain figure, of walnut, mahogany, or other quality species, commanded a relatively high price. If the same amount of wood, of equal beauty, could be sliced into twenty-eight sheets of veneer (the standard thickness of face veneer), and mounted on a sturdy plywood base, with glue, the resulting plywood furniture could grace twenty-eight homes, rather than only one home when solid lumber was used. The quality and durability of the furniture were much improved through the use of this plywood, the cost was reduced radically, and the opportunity to enjoy beautiful furniture was multiplied manyfold.

There were, however, one or two factors that aroused some doubt as to the desirability of plywood furniture and some skeptics insisted on solid-lumber constructions. Only animal glues were available at the time, and they were not water-resistant, so that joints might delaminate when furniture was exposed to substantial moisture for a considerable time, a particularly serious problem in areas of high atmospheric humidity, such as Gulf Coast cities. In addition, some of the new plywood factories, as well as plywood departments in furniture factories, which were springing up in the East, South, and Midwest, had little background of practical experience in approved methods of gluing. The plywood of that day may have had its limitations, but these have now been thoroughly mastered by the use of waterproof resin glues and proper gluing techniques.

The few years after the turn of the century were epoch-making in plywood. Practically all of the plywood, so far described, had been made of hardwood species, but there were signs of the development of the softwood-plywood industry on the Pacific Coast, where immense clear logs of Douglas fir were available, and admirably adapted to veneer and plywood production. Softwood plywood had been used in limited quantities for door panels about 1890–1895, displacing the solid-lumber panels that had to be tapered to thin edges and fitted into grooves. Such solid panels either withdrew from the grooves or split down the middle, due to inevitable shrinkage, and the doors soon became unsightly.

The development of the western softwood-plywood industry dates from 1905, when a few Douglas-fir plywood panels were exhibited at the Lewis & Clark Centennial Exposition in Portland, Oregon. They were essentially handmade with animal glues, from veneers that had been cut for fruit packages and crates. It was, however, the start of the structural plywood program that was destined to become a large industry, as well as a vital factor in many types of buildings. Softwood plywood on a mass-production basis is in distinct contrast with hardwood plywood, usually on a custom-made basis, which is too costly for most structural purposes, except where appearance is the dominating factor.

Another milestone in this period was the development of wood glues from starch by Frank G. Perkins. This vegetable glue, preferably from cassava or tapioca flour, provided the

first low-cost glue for woodwork. While it had no more water resistance than animal glues, its use encouraged the making of plywood for many purposes where low costs were imperative.

PLYWOOD IN 1910 TO 1930

The mechanical production of fir plywood began in 1910, with three producing units, their chief output for the next few years being plywood panels for fir doors. It was not until about 1920 that fir plywood became important as a structural material. However, the distributed strength of fir plywood, which was cheaper than hardwood plywood, made it a most desirable material for the automobile bodies of that day, for both passenger and commercial vehicles. There were ten plywood-producing units in 1924, turning out a total of 125,000,000 sq ft on a 3/8-in. basis, and by 1930 the number had grown to seventeen turning out 305,000,000 sq ft.

In 1910 only animal and vegetable glues were available to the makers of fir plywood, but about 1916 casein glues also became commercially obtainable, followed by the soybean glues about 1927. While the soybean glues were moderately moisture-resistant, and casein joints had good resistance to weather exposure, neither of them permitted the production of weatherproof plywood, which eventually became well established as the "exterior" type of fir plywood. Hence in 1920–1930 the structural uses of fir plywood were limited, and it could not be employed successfully under severe weather exposure or for most marine applications. In spite of these limitations, the fir-plywood industry of the Pacific Coast had made a significant beginning.

It was about 1912 that Henry Haskell demonstrated the use of blood albumin as a waterproof glue for canoes. He pressed cross-laid hardwood veneers, coated with a preparation of soluble dried blood, between pairs of rigid forms, one of which was steam-heated. This heat coagulated the albumin, irreversibly, and produced the most water-resistant glue bond that had been developed up to that time. Dried blood, before coagulation, is soluble in water; but after coagulation by heat, this characteristic is altered and it becomes highly water-resistant. This albumin glue process was the basis of the organization of the Haskelite Corporation, which soon developed multiopening hot-plate presses and produced albumin-glued plywood in standard flat sheets. This hot-pressed plywood, with its unusual water resistance, was hailed as a major step in extending the utilization of plywood. Haskelite is believed to be the first commercial organization to establish its own research laboratory for the testing of glues, and for the development of new plywood products.

There was an intensive development of aircraft during World War I (1914–1918), and this hot-pressed albumin plywood proved to be an important structural material in the larger types of airplanes of that day. Several other companies installed hot presses and an impressive start was made in producing what was then called "waterproof" plywood, although it fell short of the maximum waterproofness attained by the heat-reactive resin adhesives of the 1930's.

Another new plywood adhesive, casein derived from the curds of milk, was brought into this country from England by William F. Leicester, somewhere around 1910, and it became an important wood adhesive in about 1916. Its use did not require hot-pressing, but the cementing action of the casein-lime combinations produced plywood bonds of high water resistance. Casein-glued joints, thereafter and until waterproof synthetic resin adhesives became available, were important in the manufacture of both hardwood and softwood plywood, and may have limited the commercial growth of albumin-glued plywood.

Still a third new plywood glue was originated in this twenty-year period, that of soybean, which was the result of research by Irving F. Laucks. About 1927–1928, after inconclusive results with soybeans from the Orient, the successful cultivation of soybeans in this country provided an adequate supply of good-quality soybean meal at a low cost. This meal was found to make an especially satisfactory glue for fir plywood, with more water resistance than that of vegetable glue, and in a comparatively low cost range.

During this twenty-year period the use of plywood in furniture continued to grow, until practically all surfaces of substantial area in quality furniture were made of plywood. Casein glues provided a distinctly moisture-resistant glue, which was used in furniture likely to be subjected to severe climatic conditions.

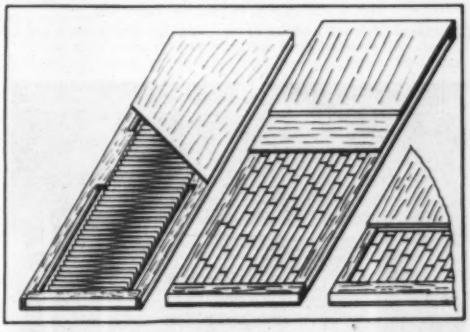

FIG. 8 FLUSH DOOR CONSTRUCTION: RIGHT, SOLID WOOD BLOCK CORES: LEFT, SEMIHOLLOW CORES WITH EXPANDED VENEER STRIPS
(Courtesy Roddis.)

The making of flush doors was started about 1918 by William H. Roddis, and offered a sturdy, sanitary, and sightly door for public buildings, schools, hospitals, and the like. Such a plywood door, relatively free from shrinking and warping, could be fitted tighter, could easily be kept clean, and would withstand exceedingly severe service. It was not until about 1938 that the solid-lumber core in flush doors was supplemented by a semihollow core, Fig. 8, which substantially reduced the weight and brought the cost down to where flush doors, with their advantages, could be widely used for homes in modest price ranges.

PLYWOOD IN 1930 TO 1950

These last twenty years appear to have shown more developments in plywood than any earlier period of similar length, perhaps because the events are too close at hand to present a clear perspective.

One of the major developments of the 1930's, if not the most important in the one hundred years of plywood under review, was that of synthetic-resin adhesives and of hot-pressing, both of which, in combination, resulted in the making of waterproof plywood. This step immeasurably broadened the field of plywood utilization in boats, in aircraft, and in prefabricated housing, Fig. 9, as well as in many ramifications of these industries. Tego film, the pioneer of the phenolformaldehyde resin adhesives, was available on an import basis from Germany about 1933, and by 1937 was made in this country by Rohm & Haas. Closely following were the ureas, the melamines, and the resorcinols, all synthetic-resin adhesives, ranging from high water resistance to complete waterproofness. Some were supplied with catalysts for hardening at room temperatures,

FIG. 9 GUNNISON PREFABRICATED HOME
(Douglas fir plywood used for inside walls, for outside walls, and for roof. All plywood glued to framework. Courtesy U. S. Steel.)

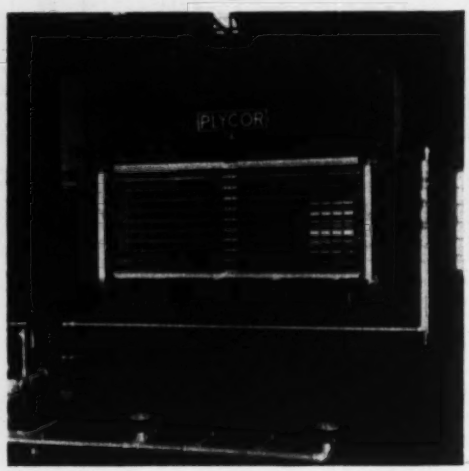

FIG. 10 MULTIOPENING HOT PRESS FOR MAKING RESIN-BONDED PLYWOOD
(Courtesy Plycor.)

but the most durable of all proved to be hot-pressed phenolic plywood. Some of the multiopening hot presses of the blood-albumin era (about 1915) were resurrected and "dusted off," hot presses of improved design were imported from Europe, and soon even better types, Fig. 10, were made in this country. By 1940 more than one hundred hot presses were in service, both in plywood factories and in shops making furniture, pianos, doors, and general cabinet work.

A number of combination adhesives have been developed which have substantially preserved the dominant characteristics of the resin adhesives, and have brought glue-line costs down to a moderate basis. Examples of these blends are phenol-resin-blood; urea-resin-flour; resorcinol-phenol-resins; and melamine-urea-resins. The net effect of these combinations has been t mprove the moisture resistance of plywood joints in cost ranges that are reasonably competitive with many of the cheaper glues.

These improvements in adhesives and their techniques greatly benefited the Douglas-fir-plywood industry, which was now able to produce an "exterior" type (phenolic) that was the ultimate in water resistance. The growth of this industry, closely grouped together geographically in three northwestern states, under a strong trade association, the Douglas Fir Plywood Association, has been spectacular, as can be noted from the graph, Fig. 11, and its impact on the building industry has been enormous.

This growth in the consumption of fir plywood, in standard sizes, encouraged the establishment of wholesale distributing warehouses by the United States Plywood Corporation, headed by Lawrence Ottinger, who started his jobbing activities in 1919, and followed them by incorporation in 1937. This organization is now the undisputed leader of the industry, although other important chains of distributors have followed in its wake. Hardwood plywood was included in the warehouse program, but in substantially lesser volume, since much of it was still made in custom sizes for furniture, pianos, cabinets, trim, and the like.

Molded plywood, with omnidirectional pressure from flexible bags, was an important development in 1939–1945, and provided plywood of compound curvature for small boat hulls, Fig. 12, for aircraft fuselages, nacelles and wings, for radar and communication equipment, and the like. It supplied the opportunity for an entirely new range of plywood designs, but its commercial importance in the civilian economy of today appears to be somewhat limited. In its place, cushion pressure, Fig. 13, with thin inflatable bags between pairs of rigid molds, is finding practical use in the furniture and allied industries.

Laminated lumber employs many of the techniques and adhesives used in plywood and has profited by the advances

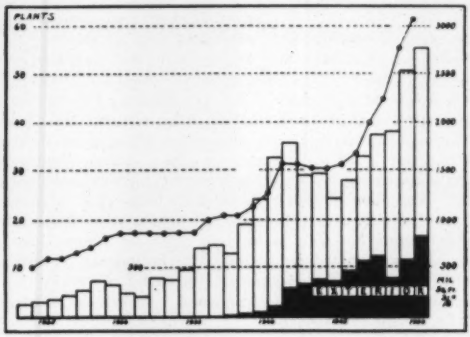

FIG. 11 PRODUCTION CHART FOR DOUGLAS FIR PLYWOOD, 1923–1951

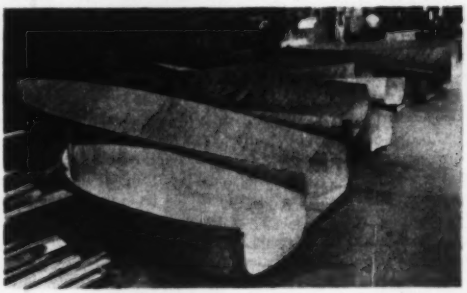

FIG. 12 MOLDED PLYWOOD BOAT HULLS
(Courtesy U. S. Plywood.)

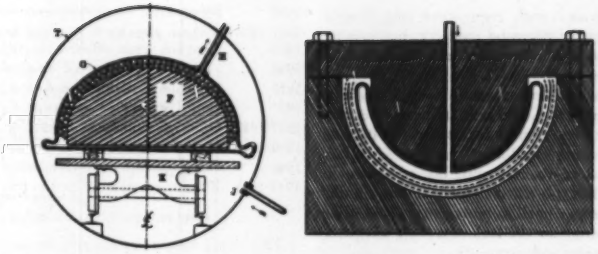

FIG. 13 MOLDED PLYWOOD PROCESSES; LEFT, AUTOCLAVE METHOD WITH DEFLATED FLEXIBLE RUBBER BAG; RIGHT, SELF-CONTAINED RIGID FORMS WITH THIN INFLATABLE RUBBER CUSHION

FIG. 14 VENEER LAMINATED CONSTRUCTION IN TENNIS RACKET
(Courtesy A. G. Spalding.)

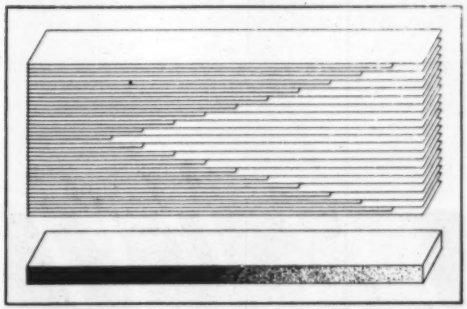

FIG. 15 VARIABLE-DENSITY LAMINATED WOOD; ABOVE, IMPREGNATED VENEERS IN OPEN ASSEMBLY; BELOW, AFTER PRESSING SAME AT 2000 PSI AND 300 F
(Variable density indicated by degree of shading.)

made in that industry. Laminated timbers belong in the lumber-fabricating field, while laminated veneers, with the grain direction parallel in all layers, are best made in plywood shops. This veneer-laminating procedure provides a simple alternative for difficult bends and curves in solid lumber, and has been found useful and reasonable in cost for furniture, auto bodies, boats, and sport equipment, Fig. 14.

The resin impregnation of these layers of veneer has opened up another entirely new field, that of increasing the density of wood under high pressures. Hardwood equivalents can be made of impregnated softwoods, and the excess density can be localized as required, Fig. 15. This process offers an answer to many problems where special areas of high density can prolong the useful life of many wood products.

While plywood is normally made of all-wood layers, many modifications have been developed, i.e., plymetals with inner or outer layers of metal (about 1915) for severe service as in truck bodies; paper or fiber-faced plywood for smooth dense surfaces adaptable for painting; plastic-faced plywood for both decorative and general-utility purposes; inner or outer asbestos layers for fire protection, and the like.

The application of electronic heat for curing heat-reactive resin adhesives, occurring in 1942–1947, has been a technical development of importance in shortening the time of cure for these highly water-resistant resin adhesives. Effective heat can be concentrated at the glue joint, thus largely eliminating the unnecessary heating of the adjacent wood, a costly and unavoidable feature when steam heat is used.

During these one hundred years, up to 1950, plywood has become well established as an improved type of wood, which can be employed in a constantly growing number of useful and economical applications.

MACHINERY FOR VENEER AND PLYWOOD

This unprecedented growth of the plywood industry could not have been accomplished without the development of adequate and appropriate mechanical equipment. It has been necessary in this review to concentrate on what has happened to plywood, and the story of its machinery, unavoidably, has been limited to a few strategic items. These developments in machinery, however, have grown in lines parallel to the progress of plywood. Distinct credit should be extended to the many machine and tool companies which have exhibited the ingenuity and aggressiveness needed to keep in step with the rapid advances of the plywood industry.

EDUCATION IN PLYWOOD DEVELOPMENT

Schools and colleges, for many years, have done an excellent job in training foresters, but the major emphasis has been on propagating, nurturing, protecting, and harvesting trees. Only minor attention has been devoted to the utilization of wood, or to the conversion of the raw material in the log into useful and attractive end products, such as furniture, cabinets, doors, and other like products. Within the last twenty-five years several leading schools have offered courses in wood utilization, and their graduates have acquitted themselves with credit. Graduates from engineering schools have made excellent records in

the woodworking industries. Such men have contributed substantially to progress in the plywood industry, but it is to be regretted that there have been so few of them in such a large industry.

It is almost axiomatic that schools maintain courses of study which continue to attract students, and it is an inevitable conclusion that relatively few youngsters have chosen the field of woodworking. It may be suggested that woodworking has been such a familiar subject as not to inspire one to choose it as a technical career. While plywood did not profit significantly from technical training, until quite recently, it is difficult to place the responsibility for the lack of a more adequate educational background in this industry.

ENGINEERING IN PLYWOOD

The first definite recognition of woodwork manufacturing by organized engineers may have been the establishment of the Wood Industries Division of the ASME in December, 1920. The reader of this paper may wonder at the credit given to engineering accomplishments in plywood and plywood machinery prior to that time. It is to be regretted that there was so little interchange of technical information between professional engineers and woodworking management prior to 1920. Woodworkers for many generations, however, have shown ingenuity and enterprise in developing their industry, and have exhibited many qualifications that were, and still are, of a distinctly engineering nature. Engineering, although unrecognized as such, was a significant factor in many other industries long before engineering societies came into existence. Many of the skills, now considered as engineering, have been demonstrated by leaders in industry for untold years in the past. Hence it is wholly logical to credit woodworking, and plywood in particular, with distinct engineering achievements, even though those who directed such progress did not regard themselves as engineers.

THE CHRONOLOGY OF PLYWOOD

A bird's-eye view of the more important of these progressive developments in plywood and glues, with approximate dates, may give a realistic touch to the advances that the plywood industry has made in this century of applied engineering.

1800	Bentham patent for shaving wood into thin sheets.
1830	Piano pin blocks made of cross-laid sawn maple veneers.
1840	Dresser patent for rotary veneer lathes.
1855	Steinway originated curved grand-piano rim.
1865–1868	Mayo patents for plywood.
1867	Sewing-machine lids made of curved plywood.
1870	Veneer lathes known to be in use; slicers came earlier.
1872–1876	Gardner patents for plywood.
1875	Gardner catalogs of perforated plywood seating.
1879	Cabinet organs first used plywood.
1883	Plywood desk tops, 5-ply construction, with lumber cores.
1885–1888	Plywood shooks first developed for packaging.
1890–1895	General adoption of plywood for furniture.
1895	Door panels first made of softwood plywood.
1895–1900	Figured face, 5-ply, hardwood plywood used in furniture.
1905	Douglas-fir plywood shown at Lewis & Clark Centennial Exposition at Portland, Oregon.
1905–1910	Vegetable (cassava) glue developed by Perkins.
1910	Mechanical production of fir plywood commenced.
1912	Heat-cured albumin glues used for boats by Haskell.
1914–1916	Albumin-glued plywood used for military aircraft.
1915	Haskelite starts first laboratory for developing and testing plywood.
1916	Casein glues made available by Leicester.
1916–1918	Plywood adopted as a name for the industry.
1918	Flush-door manufacturing started by Roddis.
1920	Fir plywood became important structurally.
1927–1928	Soybean glues for fir plywood developed by Laucks.
1933	Tego film (resin adhesive) available on import basis.
1936	"Exterior" (waterproof) fir plywood first made.
1937	Tego film available from domestic manufacturers.
1937	United States Plywood Corporation organized by Ottinger.
1937–1940	Other resin adhesives developed.
1939–1942	Molded-plywood techniques become practical.
1940	One-hundredth hot press installed for making plywood.
1943–1945	Electronic heat developed to cure resin adhesives.

HOW PLYWOOD IMPROVES NORMAL WOOD

This paper has reviewed, step by step, many of the features which when summarized, add up to a grand total of unprecedented achievements that plywood techniques have contributed to wood constructions. They may be itemized, briefly, as follows:

1 High material yields; since saw kerfs are eliminated, Fig. 16.

2 Shrinking and swelling reduced to almost zero.

3 Toughness; cannot be split by screws and nails, Fig. 17.

4 Distributed strength; excess lengthwise strength added to balance crosswise weakness.

5 Face veneers supported; beautiful but fragile face veneers reinforced with a sturdy base.

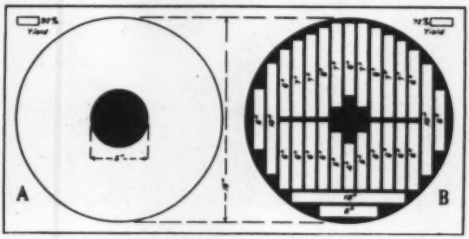

FIG. 16 VENEER VERSUS LUMBER YIELD; GROSS VENEER PRODUCT EQUALS 92 PER CENT; LUMBER PRODUCT EQUALS 72 PER CENT; BOTH OF CUBIC CONTENT OF 18-IN-DIAM LOG

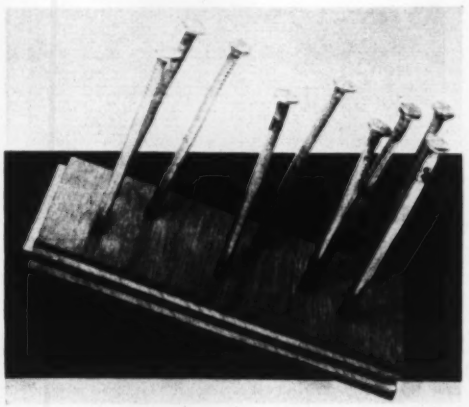

FIG. 17 NONSPLITTABILITY; 40D SPIKES 4-IN. LONG DRIVEN IN PLYWOOD FLOORING WITHOUT PREBORING HOLES

FIG. 18 BENT AND CURVED PLYWOOD CHAIR OF SWEDISH DESIGN

6 Usefulness increased; attractive choice woods, when sliced thin, can be made more widely useful.

7 Bending and curving; assembled thin veneers can be bent while gluing, Fig. 18. Thin plywood is very flexible.

8 Waterproofness; resin adhesives will outlast wood under severe weather and water exposure.

9 High strength-weight ratios; over that of steel.

10 Large areas available; far larger than those of solid wood.

11 Warping reduced to a minimum.

WHAT OF THE FUTURE OF PLYWOOD?

Prophecy is a hazardous calling and not to be undertaken lightly. Rather than attempt to peer into the crystal ball, the author prefers to outline a few of the more promising trends for the future, as they are now emerging from the plywood progress of today. After devoting more than forty years to engineering in woodwork, years which have been marked by this dynamic growth in plywood, some of these potential developments come more clearly into focus, and it may be possible to venture a few glimpses into the plywood industry for the decades just ahead. These glimpses point toward goals that are urgently needed, and even their partial realization would pave the road to important advances in the technique of the industry. They should be taken to heart by present and future leaders in the plywood industry, and implemented in every way possible.

Improving Veneer Logs by Intensive Propagation. Veneer and plywood must have long straight logs and their present availability is largely a matter of chance. Nature had been prodigal in supplying mankind with trees, but man has been most wasteful in their nurture and utilization. Tree growth is a long cycle, from fifty to two hundred years, but trees are reproducible and will grow almost everywhere. Farmers have long known how to irrigate and how to improve their crop yields by selecting sturdy and quick-maturing hybrid types. There appear to be no good reasons why improved crops of trees, suitable for veneer and plywood, cannot be planted and grown by similar but appropriate methods. The growth cycles are so long that unless the present generation takes steps to provide realistically for their successors, the future of the plywood industry will be severely handicapped. This project is now under study at the Forest Products Laboratory at Madison, Wis.

Research in Wood Products. Woodworkers in general have been singularly allergic to research. In past years few were inclined or could afford to set up such laboratories as were characteristic of chemistry, of plastics, or of electricity. The plywood leadership of today is more alert, and many companies are now able to make reasonable appropriations for research. Present income-tax laws distinctly favor such activities. Far too much reliance has been placed on the Forest Products Laboratory. This institution has done excellent work, but as a government agency, it ought, normally, to be devoted largely to primary or fundamental research. In order to maintain its operating appropriations it has been obliged to allot far too much time to secondary or applied research. Most authorities agree that applied research is a function of industry, and cannot be delegated to others without substantial sacrifices in its effectiveness.

When woodworkers put their own money into modest laboratories, as individuals, as local groups, or as trade organizations, they will assure themselves that the expenditures are justified by the results attained. With such programs of industrial research, conducted by industry, rather than by government, the plywood industry could advance much more rapidly than it has, and should develop many new and profitable products. An illustration is the Plywood Research Foundation, affiliated with the Douglas Fir Plywood Association. Research is insurance for future profits.

More Completely Integrated Machinery. There are far too many handlings of semiprocessed plywood materials, between the log in the pond and the sanded plywood panel ready to ship. In the case of all-veneer plywood with plain faces, there are at least seven handlings from the log pond to the spliced veneer ready to glue; and a minimum of seven more handlings from the glue spreader to completion. These handlings do not include inspections, nor piling for temporary (in process) storage, which could well add half a dozen more handlings. With present high wages, which have done much to raise standards of living among employees, there is little likelihood of much wage reduction, nor is it reasonable to expect that log costs will decrease appreciably. With labor and material costs on the up-grade, the most obvious remedy is mechanical handling in integrated machines, in which several sequential operations follow each other automatically. Such combinations, from lathe to splicer, are not too difficult to visualize, as several types of tandem units have been found practical. The second integration will require continuous roller pressure, with incorporated heat for curing synthetic-resin adhesives. This presents a problem of some magnitude, but similar problems, in other industries, have not been found unsolvable.

Other Urgent Needs. There are other objectives to be desired, perhaps not as conspicuous in size and scope, which will give impetus to plywood progress in the future, such as the following:

Adhesives should be supplied, ready to spread, with long working life and short curing cycles at moderate temperatures.

More efficient veneer driers should be developed, which will dry rapidly without crinkling the veneers.

Veneer lathes should be provided with double-cutting mechanisms, the first to bark and round up the log, before actual veneer cutting starts on the second.

Vigorous promotional campaigns for such wood products as recognize and employ the unusual advantages of wood. This should be constructive and discourage further activity in the direction of attempting to recover uses for wood products that may have been yielded to other competitive materials. Competition can be stimulating, but it can, and often does, divert energy from more purposeful objectives.

CONCLUSION

There is no easy and no quick way to realize these major projects, which are both provocative and challenging. Their statement, however, may help to crystalize action in the right direction. The list is far from complete, but a final wish may be expressed; that the plywood industry may accelerate its pace under the capable leadership of the generations to come; and that their achievements may far surpass those of the past century, as they have been outlined here.

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Technology in a Troubled World

(Continued from page 786)

to develop the leaders we need. To me, Dr. Wright's most important contribution in his long and useful life has been his philosophy for the maintenance of a continuing supply of new leaders—a philosophy which has been ably seconded by Chief Justice Arthur Vanderbilt of the New Jersey Supreme Court, who gave the first Roy Wright lecture.

I can assure these young men from my own experience as a Republican working for a Democratic President that it is unnecessary to deviate from one's own ideals and principles in government work. Throughout my activities in the Department of Commerce, the Economic Co-Operation Administration, and the Department of Defense, I have always been supported in a nonpartisan manner by President Truman. In these fields, the question "Will it contribute to the best interests of the Nation?" has been the determining factor in our daily work, and if in the President's judgment my recommendation did this the President endorsed it without reservation.

TRIALS OF GOVERNMENT LIFE

The kind of life that I am recommending is not an easy life. Anyone who enters the Government will find that he works about twice as hard and twice as long as he ever did in private business. He is subject to many frustrations, limitations, and criticisms. He lives in a goldfish bowl. The day that he crosses the threshold of Government he is no longer accepted as a member of the business or professional community. He becomes that strange being, a bureaucrat.

But it is democracy at work, and it is part of the best system of government ever devised to give full opportunity for the development of man and the pursuit of happiness. It can only remain effective as long as all of us, at every level, are willing to devote considerable effort to making it work. We need the best Americans to participate in Government to keep America the best. It is for this I plead, as did Dr. Wright. In these troubled times, his vision should inspire many more of us than heretofore to devote time and energy to service for the community in which we live and to encourage our younger colleagues to do the same.

OUR FUTURE IS INVESTED IN THE NATION'S YOUTH

Our young Americans are great people. I see them in the Army, the Navy, the Air Force, the Marine Corps. Every time I participate in an exercise with them, I am reassured as to the future of our country. But just as in the Armed Forces we turn raw inductees into capable fighting men within a few weeks through the inspirational leadership of their officers, young and older, thus we must in our governmental work develop a way for fuller participation, training, and experience by the youth of our country in order to preserve the finest governmental institutions in the world.

With the world becoming smaller each year in terms of distance and time, we will surely continue to have more government in our lives than we had 15 to 20 years ago, but as long as we have a large reservoir of capable and trained youth and a growing interest in government activities at all levels, I have no fear of our success in meeting the great challenge of our day—the building of a stable world with hope for all.

Modern HIGH-PRESSURE HIGH-TEMPERATURE BOILERS

1 General Design Trends and Considerations

By GEORGE W. KESSLER

THE BABCOCK & WILCOX COMPANY, NEW YORK, N. Y. MEMBER ASME

PRESENT GENERAL TRENDS

DURING the past 5 years, and particularly the past 2 years, certain definite trends in the design of modern, high-pressure, high-temperature boiler units have been well established. These trends can be traced to many diverse factors and, regardless of the effect of each individual factor, or consideration, the net result has been an improvement in over-all plant economy and in the continuity and reliability of operation.

Some years ago many operators felt that turbines were more reliable than boilers. Consequently, there were few single-boiler, single-turbine installations, and spare boiler capacity was usually available. In addition, boiler size was restricted both by fabricating limitations and fuel-burning procedures and equipment. However, as welding techniques were developed, and methods of burning fuel, cleaning surfaces, and treating water were improved, it also was found that boiler availability was actually of the same order as that of the turbine. Thus it was possible to consider new design concepts and now the trend is toward large single-boiler single-turbine installations.

A good idea of this trend can be gathered from one company's experience. In 1948, as indicated in Fig. 1, the average utility boiler unit designed by the author's company had a capacity of approximately 650,000 lb of steam per hr. However, during the past year the average capacity for an even greater number of boiler units was about 975,000 lb of steam per hr—an increase of 50 per cent in the average size of the 1948 units.

During this same period the average steam pressure (at the superheater outlet) of the company's utility boilers increased from 1435 to 1730 psi; and the average steam temperature rose from 975 to 1005 F. Further, whereas in 1948, 21 per cent of the utility capacity was for reheat, in 1951, 79 per cent of the total capacity was for reheat. Thus there is a well-defined trend toward boiler capacities in excess of 1,000,000 lb of steam per hr; steam pressures ranging from 1450 to 2700 psi, with many of the units in the range above 2000 psi; steam temperatures of 1000 to 1100 F; and the use of reheat.

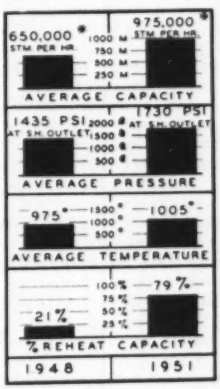

FIG. 1 1948 VERSUS 1951 DESIGN TRENDS—RADIANT AND OPEN-PASS BOILERS

Although proved boiler reliability, fabricating know-how, and improved fuel-burning techniques have led to the wide acceptance of large single-boiler single-turbine installations, other factors are contributing to the trend toward large unit capacities, higher steam pressures and temperatures, and reheat. It is definitely more economical to use single instead of multiple units, unless physical limitations are imposed by size. These economies are effected by reductions in certain fixed items per unit which must be repeated in multiple-unit installations.

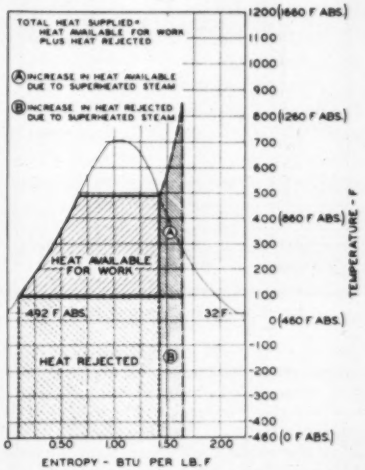

FIG. 2 RANKINE CYCLE—SATURATED OR SUPERHEATED STEAM

Another factor, and a most important one, is the increased cost of fuel. This has spurred engineering effort to develop more efficient plants.

PATHS TO INCREASED PLANT EFFICIENCIES

The direction, or path toward higher plant efficiencies has been known for many years, and perhaps it is best shown by plotting Rankine cycles as in Fig. 2, for various operating conditions. If Rankine cycles are plotted against absolute temperature as an ordinate, and entropy as an abscissa, the plots show three important considerations—the total heat which must be supplied, the heat available for useful work, and the

Presented by the Power Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS at a meeting of the Philadelphia Section, Philadelphia, Pa., April 24, 1952.

amount of heat rejected. Further, it can be readily noted that the quantity of heat rejected is a large item. This quantity depends upon the temperature of the cooling media, the quality of the exhaust steam, and the amount of regenerative feed heating. With high condenser vacuums little can be done about decreasing the temperature level at which heat is rejected, and maximum removal of heat from the steam passing through the turbine is restricted by moisture limits to prevent turbine-blade erosion. However, regenerative feed heating, which utilizes part of the steam before exhaust for heating the feedwater, reduces heat flow to the condenser cooling water, and thereby increases cycle efficiency.

In striving to improve cycle and plant efficiencies a concerted effort has been directed toward increasing the heat potential, and the useful work. This naturally first led to the use of higher steam pressures, but, since relatively large increases in pressure were required for small temperature gains, it was necessary to superheat the steam. As limitations in superheating were reached—primarily because of available materials—reheating of the superheated steam, after it had passed through a portion of the turbine, was indicated by analyses of the steam cycles as shown in Fig. 3.

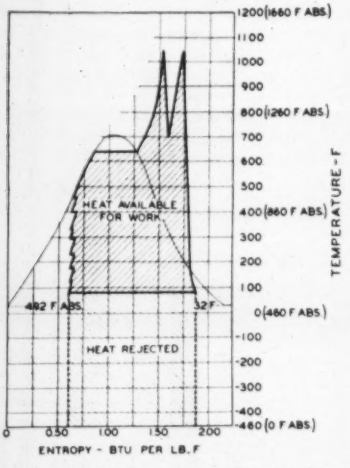

FIG. 3 MODIFIED RANKINE CYCLE—SUPERHEATED AND REHEATED STEAM, REGENERATIVE FEED HEATING

The use of the reheat cycle offers many advantages. It increases the useful work and results in approximately 4 to 6 per cent better plant efficiency than the nonreheat cycle using the same pressure and temperature. Further, the quantity of steam required for a given power output is less than that needed for a nonreheat installation, and consequently condenser capacity, pumps, piping sizes, and so on, can be reduced. Reheating the steam also minimizes turbine-blade erosion by reducing the moisture in the exhaust steam to less than 12 per cent.

HISTORICAL BACKGROUND

Although the study of steam cycles has long indicated the requirements which must be met to obtain high plant efficiencies, for a number of good reasons it has been impossible to achieve fully the advantages offered by the high-pressure, high-temperature, regenerative feed-heating, reheat cycle.

Approximately 25 years ago steam temperatures were restricted to a maximum of about 750 F by the then commercially available steels, and in an effort to increase plant efficiency reheating was tried in a number of installations. Gas reheaters were utilized and often took the form of special boiler units which reheated the steam generated and superheated in other boilers. In a few plants the gas reheaters were augmented by steam reheaters. This was necessary in those installations where there was not sufficient heat in the gases to meet the reheater requirements at low loads. Economically, reheating was, at this period, not too successful; and the greatest disadvantage accrued from the fact that with multiple low-pressure units the size and the cost of the connecting piping often was prohibitive.

Consequently, as soon as better materials became available, the trend, instead of continuing toward reheat, switched abruptly to higher steam pressures and temperatures. It was not too long before advances in steam temperature again were restricted by materials, and further increases in pressure were not desirable because of turbine-exhaust conditions. This temporary dilemma was soon solved by the use of the topping turbine which allowed new high-pressure high-temperature turbines to exhaust into existing lower-pressure lower-temperature machines. The inherent disadvantage in this trend was the limited number of conversions which could be made.

However, the great technical advances in metallurgy during the past decade once more raised appreciably the ceiling on steam temperature, and, consequently, heat cycle and plant efficiencies could be improved by increasing both steam pressure and steam temperature while maintaining satisfactory turbine-exhaust conditions. Thus, by 1948, we were truly in the era of high-pressure high-temperature steam generation—and pressures above 2000 psi and temperatures of 1000 F were not uncommon. However, with the exception of a few notable installations, particularly the 2650-psi reheat installation (2300 psi/940 F superheater outlet, 375 psi/940 F reheater outlet) at the Twin Branch Station of the Indiana and Michigan Electric Company in 1940, Fig. 4, there was comparatively little use of reheat during the period between 1930 and 1948.

REANALYSIS OF REHEAT

As fuel and operating costs continued to increase in the late 1940's, it became imperative to increase plant efficiency. The increases in load factors also contributed to this demand. Reanalysis of the basic heat cycles and studies of plant costs indicated that it was economically feasible and desirable to resort again to the use of reheated steam.

In this reconsideration of reheat there were no longer the disadvantages resulting from the use of multiple and special units. These disadvantages had been overcome by the well-established trend toward large-capacity boilers and the experience gained at Twin Branch, and a few other stations, where reheaters had been incorporated within the setting of the boiler unit. Further, because of high primary-steam pressures, the pressures in the reheater and connecting piping were considerably higher than those used in the early reheat installations. Thus, even though reheat temperatures were high, pipe sizes were not excessive and reheated-steam pressure drop met tolerable limits.

The major concern about reheat in this period of great decision centered on operation and control, that is, the problems involved in normal starting up and shutting down of both boiler and turbine units, emergency shutdowns, and the control of both superheated and reheated-steam temperatures.

The concern expressed was real and, fortunately, the steps taken to assure satisfactory operation and control were correct. The present success of reheat boiler installations and the establishment of a trend which very probably will not, as once before, be practically abandoned at some future date, is due to the foresight of those who rightfully contended that

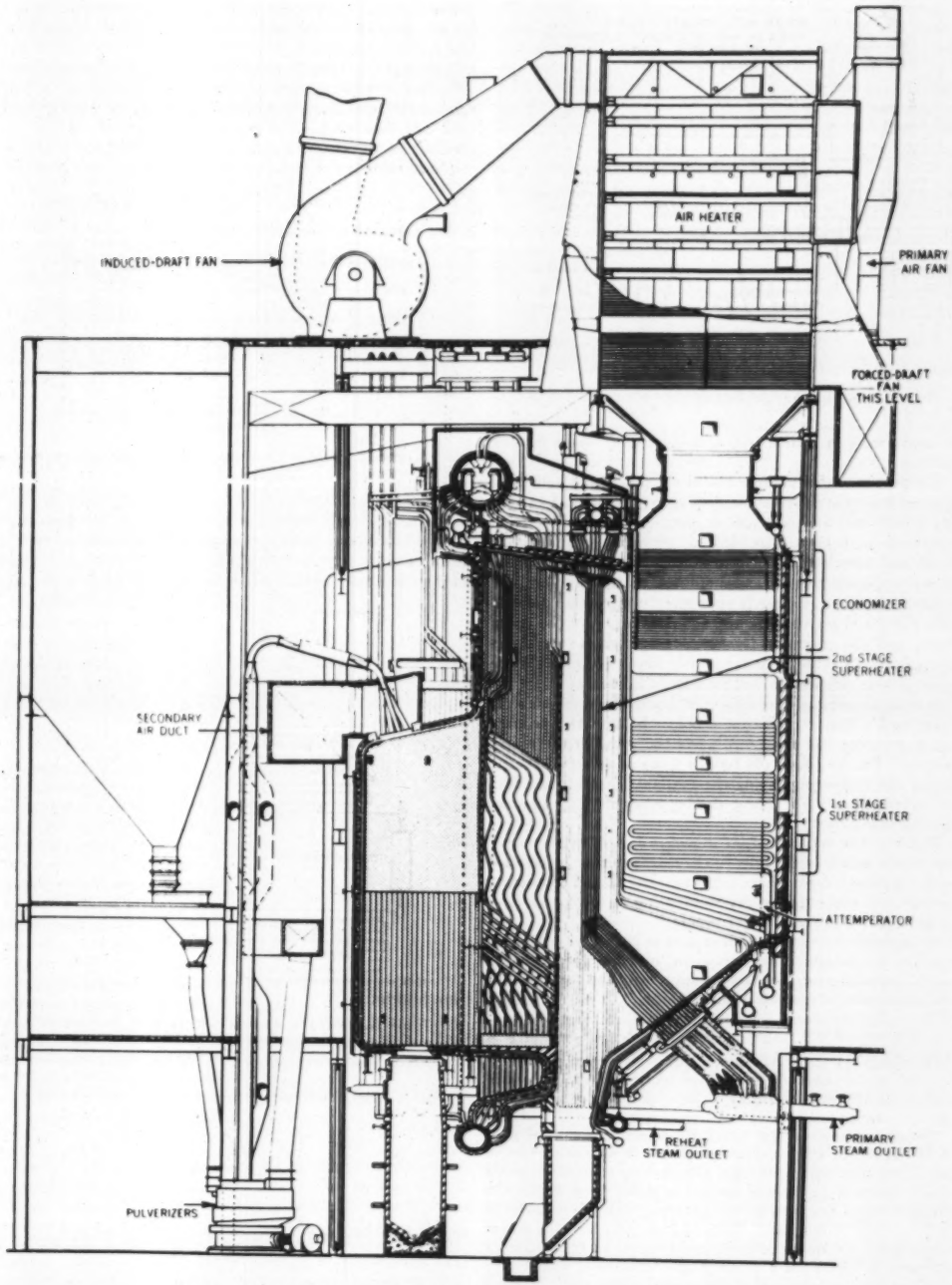

FIG. 4 OPEN-PASS REHEAT BOILER—TWIN BRANCH PLANT OF THE INDIANA AND MICHIGAN ELECTRIC COMPANY

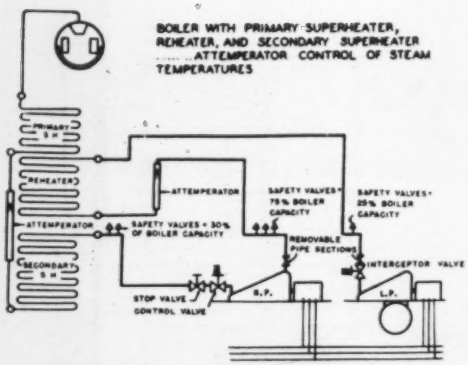

FIG. 5 LINE DIAGRAM OF BOILER-TURBINE ARRANGEMENT

reheaters were in reality just additional superheater heating surfaces.

Acceptance of this premise placed the reheat and nonreheat types of boilers in the same category in so far as normal starting up, shutdowns, and emergencies were concerned, and actual experience with practically identical operating procedures on reheat and nonreheat boilers proved this theory. This should be expected since start-ups and shutdowns of large high-pressure units are dependent primarily upon metal temperature differentials along and between the top and the bottom of the steam drum, and the necessity for limiting the gas temperatures entering the superheater or reheater to about 1000 F until the steam flow is sufficient to cool the tubes adequately.

In so far as turbines were concerned, emergency trip-outs were considered a major operating problem because the primary steam governor had no control over the speed of the reheat turbine. Further, with the large volume of steam in the reheater and connecting piping the available energy could lead to overspeeding of the reheat turbine when the high-pressure throttle was closed.

This problem was solved, as shown in Fig. 5, by the use of interceptor valves at the inlet to the reheat turbine, controlled by the main speed governors. The reheater and its connecting piping were protected by the installation of full-load safety-valve capacity in the reheater piping.

Other major problems, and always most important considerations in the design of any reheat or nonreheat boiler units, are the methods of steam-temperature control and the economical dispositions of heat-absorbing surfaces.

CONTROL OF STEAM TEMPERATURE—NONREHEAT BOILERS

Practically all utility boilers are provided with means for maintaining a constant steam temperature over a considerable load range. This is desirable if the advantages of high cycle efficiency are to be obtained at partial loads.

There are many ways in which steam temperatures are controlled in reheat and nonreheat boilers. In nonreheat boilers one of the most popular designs of superheat control is that in which sufficient superheater surface is installed to obtain the required steam temperature at the control point—usually 50 to 70 per cent of full load. Then as load increases, the steam temperature is maintained constant by means of attemperators as shown in Figs. 6 and 7. This method of control is relatively simple and, because of this, attractive. However, it does involve the use of excess superheater surface at loads above the control point and, therefore, it is imperative that full advantage of gas temperature and surface location be taken to minimize the surface requirements.

It is possible to reduce surface requirements by using a combination of radiant and convection-type superheaters; and to obtain the same steam temperature at both the control load and full load without attemperation as shown in Fig. 8. Because of the characteristics of the combined superheaters, attemperation is required for other loads in the control range.

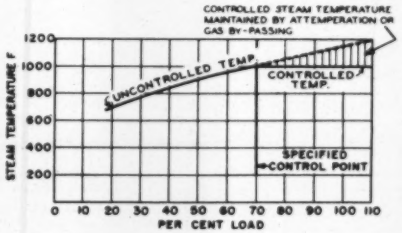

FIG. 6 STEAM TEMPERATURE CONTROL BY ATTEMPERATION OR GAS BY-PASSING

Spray, submerged-surface, and condenser-type attemperators are used to control steam temperature. The condenser type is installed in the superheater-inlet header and condenses a portion of the inlet steam by means of feedwater passing through coils installed in the header.

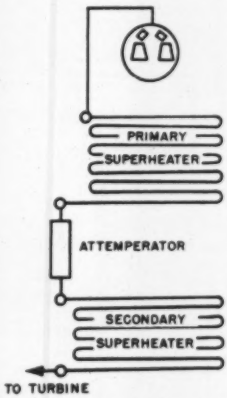

FIG. 7 DIAGRAMMATIC ARRANGEMENT OF STEAM TEMPERATURE CONTROL BY ATTEMPERATION

In the submerged-surface-type attemperators a portion of the steam is passed through a heat exchanger located in a drum, or shell, integral in the boiler circulatory system.

Spray-type attemperators utilize boiler feedwater to cool the main steam flow by direct contact. Both the surface and spray-type attemperators can be installed between superheater passes, or after the superheater.

However, unless steam temperatures are quite low, it is customary to use interpass attemperators in order to prevent excessive metal temperatures and minimize alloy requirements. Further, because of low re-

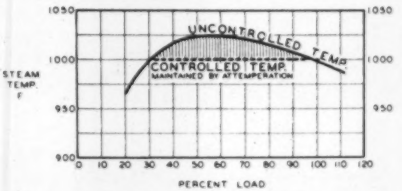

FIG. 8 STEAM TEMPERATURE CONTROL BY ATTEMPERATION—COMBINATION RADIANT AND CONVECTION SUPERHEATERS

sistance to steam flow, minimum space and piping requirements, and extreme flexibility, most installations use spray-type interpass attemperators.

Another means of controlling superheated-steam temperature utilizes gas by-passes and dampers as shown in Fig. 9. In this method, superheater surface usually is established to provide the required steam temperature at the control point, Fig. 6, and a portion of the gas is by-passed around the superheater at the higher loads. Although this method frequently is used, care must be exercised to locate the dampers properly in relatively cool gas-temperature zones, and surfaces must be arranged to minimize the use of large and idle gas passes.

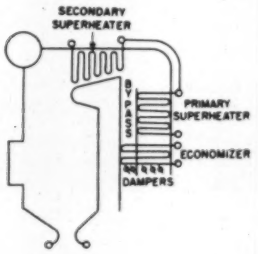

FIG. 9 DIAGRAMMATIC ARRANGEMENT OF STEAM TEMPERATURE CONTROL BY GAS-BY-PASSING

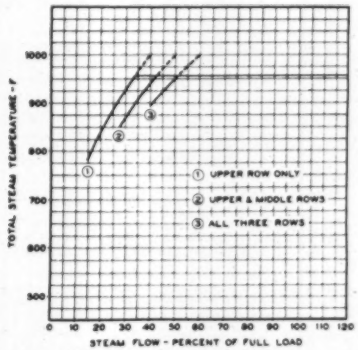

FIG. 10 STEAM TEMPERATURE CONTROL BY BURNER COMBINATION IN CONJUNCTION WITH GAS-BY-PASSING

Some designs control steam temperature by utilizing multiple furnaces. In these, the superheater is located in the discharge of only one furnace, and steam temperature is controlled by varying the firing rate in the superheater-side furnace. The units can be designed for a relatively wide control range as well as variable temperatures at any load.

Steam temperatures also are affected by burner proximity and furnace effectiveness, and therefore they can be controlled by spacing burners and/or changing the direction of burner flame propagation by burner positioning. Further, the superheater surface can be set to obtain the required temperature at full-load operation, and the steam temperature can be maintained at lower loads by providing for relatively close burner proximity to the superheater and less effective furnace heat absorption. However, a margin of reserve should be provided in the furnace exit-gas temperatures at high loads to allow elevation of the burner flames at these loads in the event that surface requirements are inadequate. Fig. 10 shows actual test results on a unit employing both gas-by-passing and burner-level control. Temperature is maintained constant at half load and higher loads by gas-by-passing. By proper selection of burners, temperature can be maintained down to about one-third load.

Finally, steam temperature can be controlled by gas recirculation—a method predicated upon certain fundamental laws of heat transfer. In this method of control a portion of the products of combustion taken from a relatively cool temperature zone—usually the boiler or economizer gas outlet—is recirculated back into the furnace as shown diagrammatically in Fig. 11. The gas is introduced into the furnace at a location to avoid interference with the combustion process, and provides a means

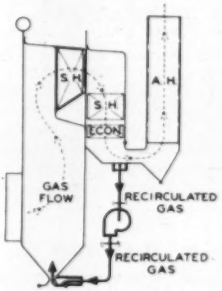

FIG. 11 DIAGRAMMATIC ARRANGEMENT OF STEAM TEMPERATURE CONTROL BY GAS RECIRCULATION—HORIZONTAL-FIRED BOILER

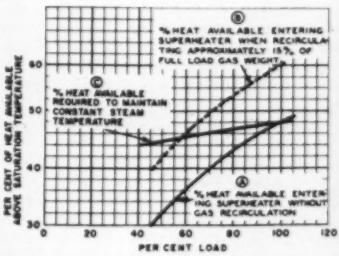
PER CENT OF HEAT AVAILABLE ABOVE SATURATION TEMPERATURE
60
50
40
30
0 20 40 60 80 100 120
PER CENT LOAD
③ % HEAT AVAILABLE ENTERING SUPERHEATER WHEN RECIRCULATING APPROXIMATELY 15% OF FULL LOAD GAS WEIGHT
Ⓒ % HEAT AVAILABLE REQUIRED TO MAINTAIN CONSTANT STEAM TEMPERATURE
Ⓐ % HEAT AVAILABLE ENTERING SUPERHEATER WITHOUT GAS RECIRCULATION

FIG. 12 STEAM TEMPERATURE CONTROL BY GAS RECIRCULATION—TYPICAL EFFECT ON PER CENT HEAT AVAILABLE ENTERING SUPERHEATER

of modifying the absorption of heat by the furnace walls, thus controlling the quantity of heat in the gases leaving the furnace and, consequently, the heat available for superheating steam as indicated in Fig. 12. The effectiveness of the furnace heat-absorbing surface is modified through a blanketing effect which is dependent upon the amount of gas recirculated and the location and manner of reinjection. With gas recirculation, a greater quantity of gas passes over the convection heat-absorbing surfaces and thus heat-transfer rates are increased.

Variations in average furnace exit-gas temperatures, when recirculating gas, are not as pronounced as those obtained with burner positioning. This is important if there is a deficiency of superheater surface. Under these conditions it would be necessary to resort to gas recirculation, or burner positioning, at high loads to obtain the desired steam temperature. There would be very little change in furnace exit-gas temperature when recirculating gas; however, with burner positioning the required furnace exit-gas temperature might be sufficient to cause slagging.

When using gas recirculation the superheater surfaces can be established to meet the full-load temperature requirement and steam temperatures maintained at partial loads by varying the amount of recirculated gas, Fig. 13. The recirculated gas increases resistance to gas flow across the boiler unit, but if it is used only at loads below full rating, no allowance for

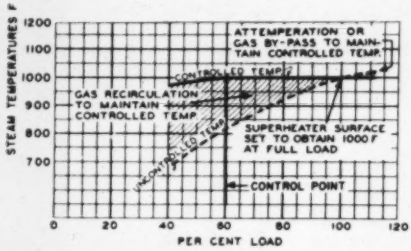

FIG. 13 STEAM TEMPERATURE CONTROL BY GAS RECIRCULATION

its use is necessary in the establishment of forced and induced-draft-fan sizes.

CONTROL OF STEAM TEMPERATURES—REHEAT BOILERS

Although any of these methods can be used to control the steam temperatures of nonreheat boilers, the addition of reheat presents another variable since many reheat units are designed not only for constant superheat but also for constant reheat temperatures over a good portion of the load range, in order to obtain high cycle efficiency at partial loads. Thus both superheat and reheat temperatures must be controlled simultaneously.

This simultaneous control can be effected by using attemperators for both the superheater and the reheater. With this method it is necessary to provide sufficient surface to obtain both the required steam and reheat temperatures at the control point, and remove heat by attemperation at the higher loads. Because of the large amount of heat which must be removed by the attemperators at top load, they are usually of the spray type.

This method of control also is limited in load range when high superheat and reheat temperatures are used, since it is not unusual in high-temperature installations for the superheater and reheater to absorb 45 to 50 per cent of the total heat absorbed in the unit. Therefore, to obtain the required superheat and reheat absorption at the control point, without installing an inordinate amount of surface, fairly high furnace gas temperatures on the order of those shown in Fig. 14 may be required. If this is the case, the furnace exit-gas temperatures may be excessive at the top loads and, with this method of control, they can be decreased only by the consideration of a smaller control range.

Twin furnace units also can be provided with both superheaters and reheaters. However, if only two furnaces are available to control three factors—capacity, steam temperature, and reheat temperature—by variable firing, another means must be used to supplement the control. This auxiliary control is usually accomplished by attemperators.

Although gas recirculation, or burner positioning, will provide a good control range, neither method can be used alone to control both steam and reheat temperatures simultaneously. This results from the fact that the heat absorbed per pound of superheated steam is practically constant over the control range, but the heat absorbed per pound of reheated steam increases as reheat temperature is held constant with decreasing load as shown in Fig. 15. Therefore, if gas recirculation, or burner positioning, is used to maintain reheat temperature, the superheat temperature will rise above the prescribed limit as load is decreased. Conversely, if either of these methods is used to control superheat temperature, the reheat temperature will decrease with a decrease in load.

Therefore the solution has been to combine different methods of control while retaining the best features of each. This has been accomplished by using attemperators, or gas by-pass, to reduce the superheat temperature while using gas

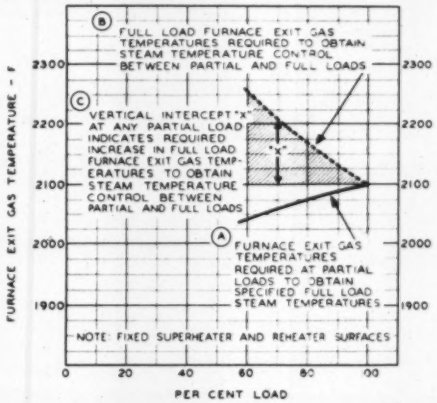
B
FULL LOAD FURNACE EXIT GAS TEMPERATURES REQUIRED TO OBTAIN STEAM TEMPERATURE CONTROL BETWEEN PARTIAL AND FULL LOADS
C
VERTICAL INTERCEPT "X" AT ANY PARTIAL LOAD INDICATES REQUIRED INCREASE IN FULL LOAD FURNACE EXIT GAS TEMPERATURES TO OBTAIN STEAM TEMPERATURE CONTROL BETWEEN PARTIAL AND FULL LOADS
A
FURNACE EXIT GAS TEMPERATURES REQUIRED AT PARTIAL LOADS TO OBTAIN SPECIFIED FULL LOAD STEAM TEMPERATURES
NOTE: FIXED SUPERHEATER AND REHEATER SURFACES
FURNACE EXIT GAS TEMPERATURE - F
2300
2200
2100
2000
1900
0
20
40
60
80
100
PER CENT LOAD

FIG. 14 STEAM TEMPERATURE CONTROL BY ATTEMPERATION—CONTROL RANGE VERSUS FURNACE EXIT-GAS TEMPERATURE REQUIREMENTS

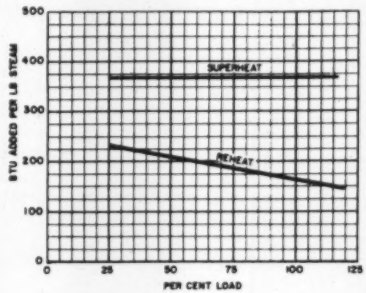

FIG. 15 TYPICAL SUPERHEAT AND REHEAT ABSORPTIONS—VARIATIONS WITH LOAD TO MAINTAIN CONSTANT STEAM TEMPERATURES

recirculation or burner positioning to raise the reheat temperature at the reduced loads. With these combinations of control, gas recirculation or burner positioning is used to control the reheat temperature over the load range, and the reheater surface can be sized to obtain the desired temperature at full load.

The superheater surface also can be established to provide the required superheat temperature at full load—and the maximum attemperation, or gas by-pass, is at some partial load. Thus these controls are the reverse of attemperator and by-pass controls on nonreheat units.

(Part 2 to be published in a later issue)

Modern MACHINE-TOOL LUBRICATION PRACTICE

By W. D. WHALEN

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MACHINE-TOOL LUBRICATION HISTORY

ON machine tools of the past generation, lubrication was not too serious a problem. Because of the limitation of the available cutting tools, surface cutting speeds were quite low, and light feeds and depths of cuts were the order of the day. Therefore the required spindle speeds were low and there was no need for a wide range of these speeds.

The art and science of gearing had not advanced to a point where it was economically feasible to use many gears. Antifriction bearings had not come into their own, so that the lubrication problem consisted mainly of slow-speed shafts rotating in plain bearings, and the slow sliding motion of carriages, and the like. An oil can in the hands of the machine operator provided all of the necessary lubrication. The development of carbide tools has made it possible to remove metal at a faster rate than ever before believed possible. Machine-tool companies must now design their machines to run faster, to carry greater loads, and to have a wider range of speeds and feeds. These operations must be carried out with a greater degree of precision than was ever required in the past.

The machine-tool companies have met this challenge in the modern high-production machine tools of today. However, in meeting this challenge it has been necessary for them to build into these machines an efficient method to properly lubricate the various components.

To lubricate a modern machine tool properly a series of lubricants often are required, each of which should be versatile and effective over a wide range of conditions. For example, the gearboxes or transmissions on today's machine tools are made up of a wide range of sizes of gears, bearings, and shafts. The speed range of some of the several shafts and gears may vary from just a few rpm to over 20,000 rpm. Likewise, the load transmitted may vary from a light load to a heavy intermittent load.

Let us consider a representative group of modern machine tools and observe how present-day designers have provided means for applying the correct lubricants in the proper amount and at the right time.

LATHES

Fig. 1 shows a modern medium-size engine lathe with the accepted nomenclature for the various units designated.

Fig. 2 shows a view looking down into the headstock of this machine after the cover has been removed. The maze of gearing and shafting combined within this small area provides 24 spindle speeds in geometric progression from 16 rpm to 1010 rpm. All shafts are mounted on antifriction bearings. The lubrication of this headstock is provided by means of a positive-displacement pump, the top of which may be seen in the upper right-hand corner of the headstock.

The pump is connected directly to the main drive shaft and operates at constant rpm so that a constant supply of lubricant is supplied at all times, regardless of the spindle speed at which the machine may be operating. The oil reservoir is in the bed of the lathe. The oil is pumped from this reservoir through a filter. From the filter it passes through tubing direct to the channel which runs around the top of the headstock casting. From this channel the oil is fed through drilled passages to all of the antifriction bearings on which the shafts are mounted. Copper tubes also lead from this channel to drop oil on the various gears. The main supply line from the filter to this channel is also drilled to spray oil on some of the higher-speed shafts and gears, so that a mist will be thrown around the entire inside of the headstock.

The oil spraying from the tubing and from the overflow from the oil channel in the top of the headstock cascades down over the gears and shafts to the reservoir in the bed underneath the headstock.

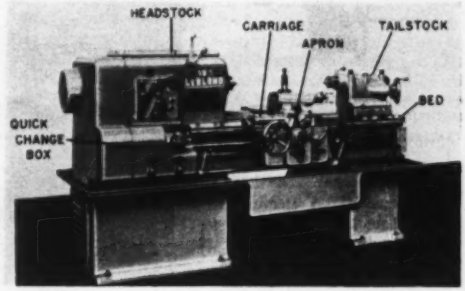

FIG. 1 MEDIUM-SIZE HEAVY-DUTY ENGINE LATHE

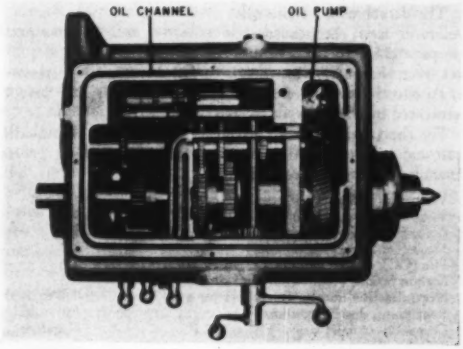

FIG. 2 HEADSTOCK OF ENGINE LATHE WITH TOP COVER REMOVED

Contributed by the Production Engineering Division and presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15-19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

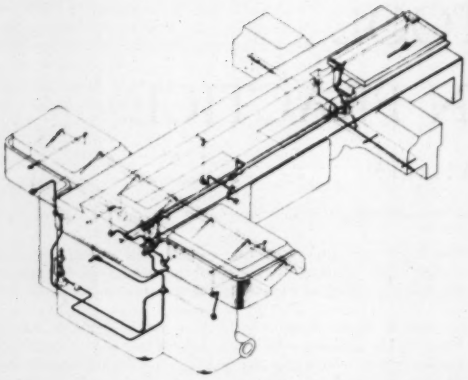

FIG. 3 LUBRICATING SYSTEM ON A 40-IN. LATHE APRON AND CARRIAGE

not only is required to lubricate the gears and bearings within the apron, but also the sliding ways of the carriage on the bed, and the sliding ways of the cross slide on the dovetail on top of the carriage.

Automatic and complete lubrication of the combined unit is obtained by means of a cam-operated piston-type pump located in the oil reservoir at the bottom of the apron. The pump is operated at a speed determined by the speed of the feed rod. The faster the rate of feed, the faster the pump works and thus the more oil it delivers.

The lubricant is directed by means of tubing and drilled passages to metering units at all of the various points where lubrication is deemed necessary.

METERING UNIT

A section through a typical metering unit is shown in Fig. 4. Note that the meter unit contains a felt filter which protects the bearing against any possible dirt, chips, or lint that may have worked into the distribution line. In the case of the metering orifice, the size of opening determines the rate of oil feed to the bearings. These units are made with various orifice diameters which deliver the required quantity of oil

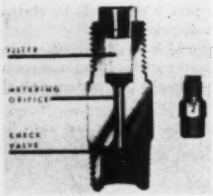

FIG. 4 SECTION THROUGH METERING UNIT USED ON CENTRALIZED LUBRICATION SYSTEMS

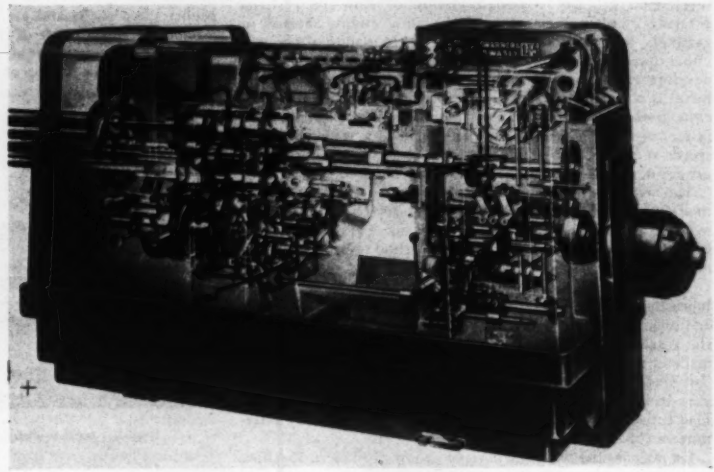

FIG. 5 LUBRICATION SYSTEM USED ON A 5-SPINDLE AUTOMATIC BAR MACHINE

This same pump also delivers filtered oil to a reservoir in the quick-change box, where it is directed by drilled passages and tubing to the bearings and gears. From the quick-change box the oil drains back to the reservoir in the bed of the machine.

The detachment of the oil reservoir from the headstock proper and the spraying of the oil over the gears, allowing it to fall down to the reservoir, is an effective means of carrying away any heat that may be generated by the gears, or the bearings.

For the lubrication of this lathe headstock, a high-quality rust and oxidation-inhibited oil having the following general characteristics is recommended:

Viscosity (SUS at 100 F)	475–525
Viscosity index (minimum)	90
Color (NPA) (maximum)	5
Flash (OC), deg F (minimum)	375
Fire (OC), deg F (minimum)	425
Carbon residue (Conradson) (maximum)	0.3
Neutralization number (mg KOH per g oil)	0.5 to 0.10
Pour point, deg F (maximum)	15
Corrosion—copper strip—3 hr at 212 F	Negative

Fig. 3 shows a phantom view of an apron and carriage of a large-size heavy-duty engine lathe. In this unit the oil needed at a given point, such as, 5 drops per min, 10 drops per min, and so on. The flow rate is indicated by a number stamped on each unit, so that one can be selected to deliver the correct quantity of oil at the point required.

A check valve is located at the outlet end of the meter unit. This valve opens under the oil-feed pressure to assure flow in only one direction. By preventing reverse flow, the check valve maintains the line full of oil, assuring instant feed whenever the lubrication pump discharges.

A lubrication system of this type provides positive control of the oil feed to the bearings, regardless of the distance from the pump. The meter units offer high resistance to oil flow as they are the controlling factor in the oil distribution. Practically no variation occurs in oil delivery because of flow resistance in the tubing, initial bearing fit, or variation caused by bearing wear.

For the lubrication of this apron and carriage a noncorrosive, extreme-pressure type of oil, commonly known as "Slideway" oil, having the following general characteristics, is recommended:

Viscosity (SUS at 100 F)	300 to 350
Color (maximum)	8
Flash (OC), deg F (minimum)	340
Fire (OC), deg F (minimum)	360
Sulphur, per cent (minimum)	1.0
Neutralization number (mg KOH per g oil)	1.7
Pour point, deg F (maximum)	0

AUTOMATIC SCREW MACHINES

Centralized lubrication systems are built into all automatic screw machines. Fig. 5 is a typical example of a modern high-speed 5-spindle automatic bar machine with the outline of the lubrication pump and the distribution lines to the various bearings shown.

The pump used in this machine is of a type which delivers both a cyclic and a continuous flow of oil—hence the two distribution lines. The distribution line from the continuous-flow side of the pump delivers the oil to the ten spindle bearings and the spindle drum. The other forty-one bearings in the machine are supplied by the distribution line from the high-pressure cyclic side of the pump. At each bearing a meter unit, similar to the one previously shown, meters the correct amount of oil to the bearing surfaces.

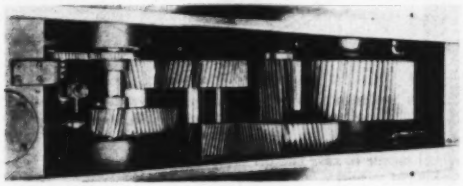

FIG. 6 VIEW LOOKING DOWN INTO A DRIVE GEAR TRAIN OF A PLANER

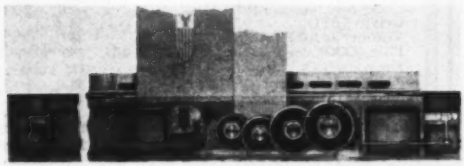

FIG. 7 SECTION THROUGH TABLE DRIVE GEAR TRAIN OF A PLANER, SHOWING OUTLINE OF LUBRICATION SYSTEM

All components of the lubrication system are enclosed by the machine housing, thus protecting them against damage. A pair of pressure gages, mounted in full view of the operator, indicates the proper functioning of both systems at all times.

For this machine, the manufacturer recommends a turbine oil of 180 to 220 viscosity, having a neutralization number of 0.05 maximum and a steam emulsion rate of 60 maximum.

PLANER

Planers, because of the nature of the work they perform, must be rugged in construction and still retain their precision qualities.

Lubrication, particularly of the table on the bed, has always been a difficult problem for planer manufacturers. This problem became more acute with the advent of carbide cutting tools and the resultant demand for faster cutting speeds. In modern planers, the rate of travel of the table may be as high as 300 fpm. Some have been built with a table travel of 450 fpm. With this increased speed, the frictional heat generated by the cast-iron table sliding on the cast-iron bed is sufficient to cause a distortion in the table, making it impossible to finish parts to the required accuracy. This distortion results from the uneven distribution of heat vertically throughout the table. The ways of the table sliding on the bedways become quite warm, while, because of the table depth, the top portion of the table remains cool. This causes a nonuniform expansion (or distortion of the table).

A great deal of research has been devoted to this particular problem. Various types of bearing materials have been tried as inlays on the bearing surfaces of the table. It has been determined that practically all materials of a metallic nature have too high a coefficient of thermal expansion which causes uneven expansion of the table.

Experiments have been conducted with laminated-phenolic-plastic inlays for the tableways. This material has a low coefficient of thermal expansion and a low coefficient of friction. It has proved very satisfactory, greatly reducing the distortion previously encountered and is now widely used for sliding-way surfaces. Being nonmetallic and rubbing on metal, the danger of cutting and scoring is reduced. Even with the use of plastic material, however, it is absolutely essential to provide thorough lubrication.

Fig. 6 shows a phantom view of a heavy-duty planer drive. The planer table reciprocates back and forth so that the gears must absorb the stresses created by accelerating the table rapidly to the cutting speed at the start of the stroke and then decelerating rapidly to a stop and reverse at the end of the cutting stroke. As a result the gears are subjected to reversals of high stress.

Fig. 7 shows one method of lubricating the gears, bearings, and the tableways. Note that the larger gears of the drive dip into the oil contained in the gear case. A positive-drive oil pump delivers the oil from the reservoir through a filter into a distribution line from which take-off lines lead to all the bearings and to the tableways. Pressure is maintained in this distributing line at a given value by a pressure-relief valve. The pressure must be controlled carefully and not allowed to go too high or it will act as a hydraulic jack on the underside of the table, lifting it away from the bed and causing inaccuracies in the work being planed.

Fig. 8 shows the method adopted by the manufacturer of this machine to lubricate the tableways. This is called "loop lubrication" because the oil makes a complete circuit, or loop, around the ways. Oil from the pump in the distributing line shown in the previous figure enters through pipe A. The top of the Vee on the underside of the planer table has been machined off, except for a short distance at each end. This forms a triangular pocket or reservoir for the oil between the table and the bed. From each end of this reservoir a hole is drilled through to the end of the table. A pipe is connected to this hole and goes across the end of the table and connects with a similar hole drilled through to the end of the table from the other Vee. The same procedure is followed at the other end of the table, i.e., the two triangular pockets are connected together forming a continuous circuit or loop for the oil. In addition, these end pipes are interconnected together by another pipe which runs underneath the table from one end to the other. The function of this pipe is to maintain a uniform distribution of the oil entrapped in the triangular reser-

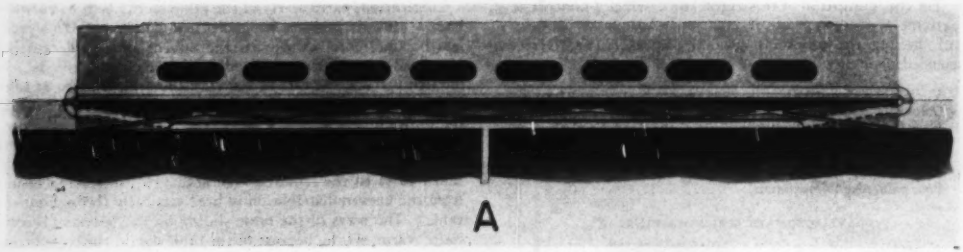

FIG. 8 SECTION THROUGH TABLE OF A PLANER SHOWING LOOP LUBRICATION OF TABLEWAYS

voir underneath the Vees as the table reciprocates back and forth.

On each side of the Vee of the table are oil grooves which crisscross the bearing surface and break into the oil reservoir so that the lubricant which is under a slight pressure can travel through these oil grooves and effectively lubricate the entire bearing surface.

With the use of laminated plastic wear strips and proper lubrication, table loads up to 50 psi of projected way area are now possible. This is twice the load that previously had been considered as the allowable maximum.

For the lubrication of the drive gears and tableways, the manufacturer recommends "an extreme-pressure chemically stable oil having excellent 'stick-slip' characteristics for way lubrication with a viscosity of 310-340 SUS at 100 F."

GRINDERS

The degree of accuracy and surface finish required for the correct functioning and interchangeability of parts has brought about new conceptions of measurement. We now frequently deal with a new measurement term "the microinch" (1 millionth of an inch).

Grinders are so designed and built that they are capable of producing parts to the size tolerances and finish standards required by modern practice. To achieve the necessary precision in these machines, all bearing surfaces, both rotating and sliding, must be finished accurately and the clearances must be held to very close limits. All rotating parts must be delicately balanced.

In some grinders, the clearances in bearings, particularly in spindle bearings, are much smaller than those previously considered practical. They are referred to as "zero clearance." Such clearances may be of the order of 0.0001 in. per in. of spindle diameter.

In addition, improvements in grinding wheels have made possible higher spindle speeds.

Fig. 9 shows the construction of a precision-grinder spindle bearing, termed a "Microsphere" bearing because of the close clearances with which it operates and because of its outer spherical shape. This is a one-piece steel bearing with babbitt lining. The outer spherical shape makes it self-aligning to its housing, and the split construction provides a convenient method of adjusting clearances in increments of "tenths" if so desired.

Microsphere wheel spindle bearings are forced-feed flood-lubricated from a separate reservoir within the base. Pressure for this system is supplied by a separate motor-driven pump. The required pressure is controlled by means of a relief valve.

A pressure-operated limit switch prevents the wheel motor from starting until the oil pressure in this system reaches a predetermined pressure. This switch also shuts down the wheel motor in case the oil pressure in the system falls below 5 to 8 psi.

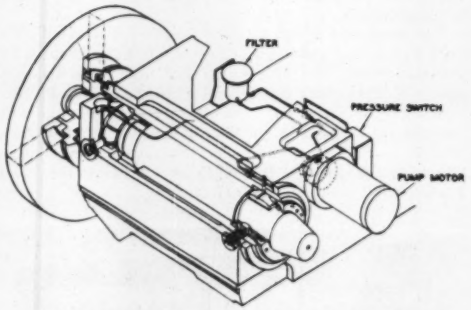

FIG. 9 SECTION THROUGH A MICROSPHERE BEARING ASSEMBLY ON WHEEL SPINDLE OF A CYLINDRICAL GRINDER

The manufacturer of this machine recommends that the lubricating oil for these bearings be a high-grade paraffin-base straight mineral oil conforming to the following specifications:

Gravity (API)	38.6
Viscosity at 100 F (SUS)	46
Flash (COC), deg F	290
Fire point (COC), deg F	325
Pour point, deg F	35
Color ASTM	1 1/2

In a bearing that is supplied by a flood-lubrication system, the thin layer of oil adjacent to the bearing tends to remain motionless, owing to the adhesion between fluid and bearing; likewise the layer adjacent to the journal tends to cling to and revolve with it. The fluid between these surface layers is in a continual state of slip or shear. In a close-clearance bearing the shear forces in the fluid being drawn into the converging area between the journal and bearing, by the rotation of the journal, build up a pressure normal to the bearing surfaces. This pressure becomes great enough to support the journal and its load, preventing contact between journal and bearing. Fig. 10 shows how this pressure is built up and distributed between a journal and a single bearing segment when a film of lubricant is drawn into the wedge-shaped space between the journal and bearing segment.

Fig. 11 shows a unique design of grinder spindle bearing in which separate self-adjusting segments or shoes are free to rock on pivots to produce independent converging oil films. This is known as a "Filmatic" bearing. The pivots are located slightly off-center toward the trailing edge of the shoes. As

the rotating spindle draws oil under the shoes, the leading edges tilt outward, thus forming a wedge-shaped film between each shoe and the spindle. The converging or wedge-shaped oil films develop high pressures as previously illustrated, which being equal, force the spindle into a central position.

Because of the ability of the shoes to adjust their wedge angle to accommodate the load, it is stated that the movement of the spindle under a change in load is only a fraction of that which occurs in other types of bearings.

The bearing chamber of this spindle mounting is maintained full of lubricant at a pressure somewhat higher than atmospheric. An independent motor-driven pump supplies oil through a filter to the bearing chamber. A relief valve maintains the chamber pressure at the desired value. A pressure switch prevents starting of the spindle motor until the desired pressure has been built up within the bearing chamber.

Because of the effectiveness of the pivoted shoes in forming and maintaining an uninterrupted oil film, the manufacturer states that the lubricating fluid used is not critical. It may vary over a wide range of viscosity and composition. However, it should be of a high quality and noncorrosive.

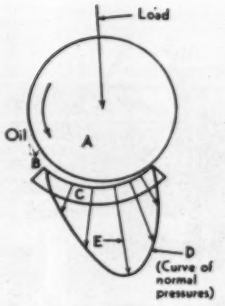

FIG. 10 OIL-FILM PRESSURE DIAGRAM BETWEEN A JOURNAL AND A SEGMENT OF A BEARING

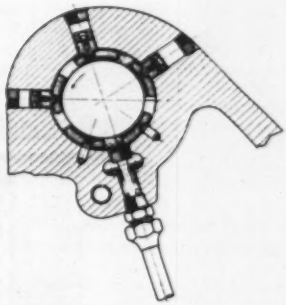

FIG. 11 SECTION THROUGH PILMATIC BEARING ON WHEEL SPINDLE OF GRINDER

SPECIAL-PURPOSE MACHINES

Fig. 12 is a section through a multiple-spindle vertical-type lathe. This machine performs different operations on six parts at one time. It has six rotating chucks and six toolholding slides arranged around a vertical center column. The entire cycle of the machine is operated hydraulically.

From the oil-circuit diagram, it will be noted that the lubricating oil is also used for the hydraulic circuit. There are two motor-driven lubricating pumps, each of which is essentially a two-stage pump, providing a medium pressure from one stage and a high pressure from the other stage.

One pump is known as the "chuck and booster pump" and provides the oil pressure for operating the chuck. The medium-pressure stage is automatically connected to the chuck cylinder to open the chuck when it passes into the unloading position. As a new workpiece is placed in the chuck and the chuck passes out of the unloading position, lines from the high-pressure stage of the pump are connected automatically with the top of the chuck-operating cylinder, closing the chuck jaws tightly on the workpiece.

The other pump is known as the "feed and traverse pump." Its medium-pressure stage automatically traverses the tool slides to the feed cams and, at the completion of the cutting operation, returns them rap-

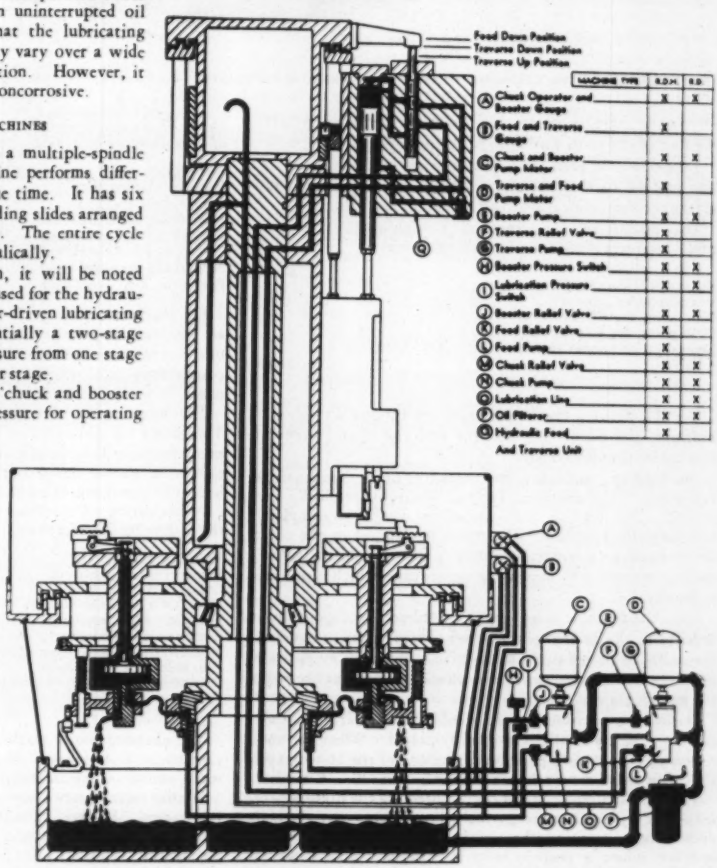

FIG. 12 SECTION THROUGH AUTOMATIC VERTICAL TURRET LATHE, SHOWING LUBRICATION SYSTEM

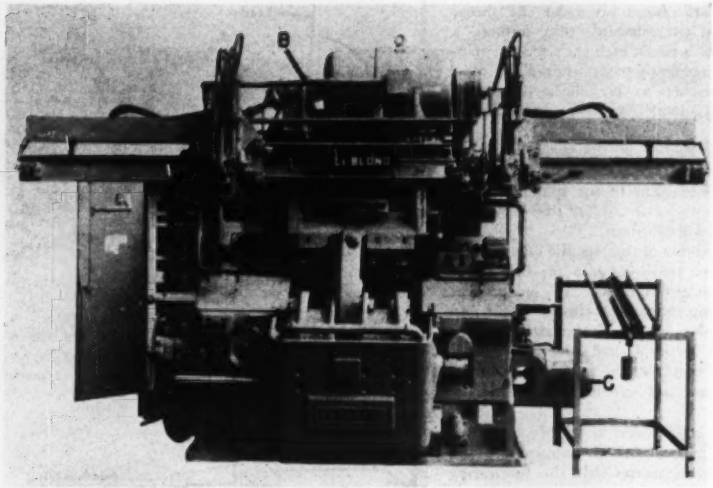

FIG. 13 AUTOMATIC CRANKSHAFT LATHE FOR TURNING MAIN BEARINGS FLANGE AND STUB ENDS OF AN AUTOMOBILE CRANKSHAFT

idly to the starting point. The high-pressure stage provides the feed of the tools through the cutting operation.

Take-offs from each of these pumps are interconnected to a line leading to the lubrication circuit of the machine, providing pressure lubrication to all important bearings.

The manufacturer recommends a high-quality "turbine-type" lubricant of the following specifications:

Viscosity (SUS at 100 F)	140–160
Viscosity index (approx)	100
Pour point, deg F (maximum)	20
Flash point, deg F (minimum)	375
Neutralization number (maximum)	0.10
Additives	Rust and oxidation-inhibited

Fig. 13 shows a crankshaft lathe for turning all the main bearings, the flange end, and the stub end of an automobile crankshaft simultaneously.

The loading, machining, and unloading of the crankshaft are automatic. The complete cycle is electrohydraulically controlled. The loading and unloading device is completely hydraulically operated. The crank is clamped in the center drive chuck by a hydraulic motor. The cycle of the turning tools is controlled by means of a master cam, which is operated hydraulically.

Since the machine must stop in a predetermined position, in order to be able to engage the power chucking unit, a hydraulic motor B is connected to the main-drive-motor shaft for positioning and stopping the center drive chucks properly at the end of the machining cycle.

During the machining cycle, while the main drive motor is running, the hydraulic motor is by-passed. When the tools return to the starting position at the end of the cutting cycle the main drive motor is automatically cut off. A solenoid valve in the hydraulic circuit opens, directing the high-pressure oil to the hydraulic motor, which slowly turns over the main drive motor, rotating the chucks to the predetermined set position where a positive stop is engaged. This locks the chucks in position for loading and unloading.

For the hydraulic system a rust and oxidation-inhibited oil of the following general specification is recommended:

API gravity at 60 F	28 to 32
Viscosity (SUS at 100 F)	145 to 155
Color (maximum)	1.5
Flash (OC), deg F (minimum)	385
Fire (OC), deg F (minimum)	430
Carbon residue (Conradson) (maximum)	0.02
Neutralization number (mg KOH per g oil)	0.03 to 0.10
Pour point, deg F (maximum)	25

For the lubrication of all the bearings and sliding surfaces an automatic lubricator A is incorporated. Metering units of the type previously described are used for proportioning the correct amount of oil to each of the 48 bearings on this machine.

The lubricator is driven by a separate individual motor. This motor is connected in the circuit with the hydraulic pump motor and the main drive motor. The main drive motor cannot be started unless both the lubricator motor and the hydraulic pump motors are running.

A lubricating oil recommended for this machine should meet the following specifications:

Viscosity (SUS at 100 F)	475–525
Viscosity index (minimum)	90
Color (NPA) (maximum)	5
Flash (OC), deg F (minimum)	375
Fire (OC), deg F (maximum)	425
Carbon residue (Conradson) (maximum)	0.3
Neutralization number (mg KOH per g oil)	0.05 to 0.10
Pour point, deg F (maximum)	15
Corrosion—copper strip—3 hr at 212 F	Negative

OIL MIST

The ultimate aim in machinery lubrication is to maintain a continuous and uniform oil film on bearings, gears, sliding ways, and so on, by automatic positive means.

Within recent years a new method, referred to as "oil-mist lubrication," has been developed, in which the oil is, in effect, atomized into a mist of microscopic particles by means of an air stream. This oil mist is then carried by the air stream through tubing to the various bearings and parts to be lu-

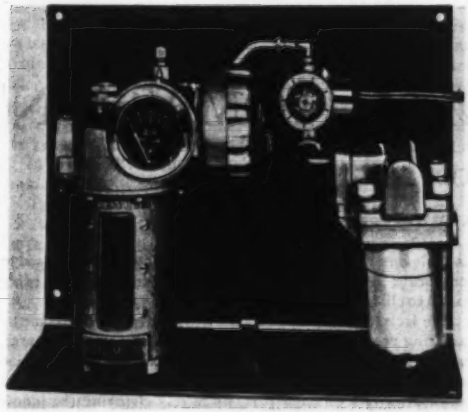

FIG. 14 COMPONENT PARTS OF AN OIL-MIST LUBRICATOR

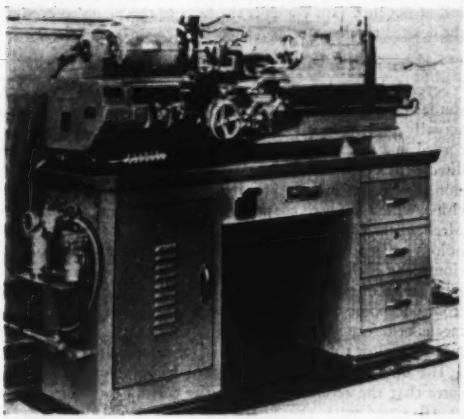

FIG. 15 APPLICATION OF OIL-MIST LUBRICATOR ON A SMALL LATHE

bricated. The pressure of the air stream circulates the mist throughout the bearing cavities. As the oil-saturated air strikes the various bearing surfaces, the oil particles collect or condense, producing an oil film on the surfaces.

Oil-mist lubrication was first used on pneumatic tools, then on ball and roller bearings used on grinder spindles. It was first used with a twofold objective in view: (1) to obtain continuous automatic lubrication, and (2) simultaneously to protect bearings against the ingress of foreign materials. This method maintains a pressure within the bearing housing which is slightly above atmospheric so that the surrounding abrasive or dirt-laden air cannot penetrate the bearing.

While the oil-mist system is comparatively new, it has been used on some machine tools, particularly for high-speed shafts and spindle bearings, where with conventional lubricating methods objectionable fluid and frictional heat was generated.

Fig. 14 shows the component parts of an oil-mist lubricator, consisting of a water separator on the compressed-air line, a solenoid control valve, and the lubricator.

Fig. 15 shows the application of an oil-mist unit to a small bench lathe where 18 individual points are lubricated. It serves the lubrication requirements of the headstock where spray fittings are used for applying oil mist to the spur gears enclosed in the housing. Also, the tailstock and the ways are lubricated by this unit.

CONCLUSION

All machine-tool builders are studying ways and means of lubricating their machines more effectively and efficiently. Likewise, the lubricating-device manufacturers are providing more efficient automatic centralized lubrication devices. The few examples shown are but a sketchy cross section of the entire industry, but they are indicative of the thought and study being given to lubrication.

ACKNOWLEDGMENTS

The author wishes to express his sincere appreciation for the splendid co-operation of the following: The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio; Bijur Lubricating Corporation, Rochelle Park, N. J.; Warner & Swasey Company, Cleveland, Ohio; G. A. Gray Company, Cincinnati, Ohio; Landis Tool Company, Waynesboro, Pa.; Cincinnati Milling Machine Company, Cincinnati, Ohio; Alemite Division of Stewart-Warner Corporation, Chicago, Ill.; The Bullard Company, Bridgeport, Conn.; The Carlton Machine Tool Company, Cincinnati, Ohio; Giddings & Lewis Machine Tool Company, Fond Du Lac, Wis.; The Ingersoll Milling Machine Company, Rockford, Ill.; Gisholt Machine Company, Madison, Wis.; Timken Roller Bearing Company, Canton, Ohio; Trabon Engineering Corporation, Cleveland, Ohio; Sun Oil Company, Philadelphia, Pa.; The Texas Company, New York, N. Y.; and Socony-Vacuum Laboratories, Brooklyn, N. Y.

Engineering in Management

(*Continued from page 783*)

greater and greater extent of the type of mind and thinking of the engineer to problems of management, far outweigh the negative implications which may be there, and which I think Mr. Randall has emphasized rather unduly.

Certainly, approached from the positive point of view, the prospect of an engineer entering management points the way to opportunities for applying his talents and skills in the most important field of industrial endeavor—the field of influencing and leading personnel to better results and higher goals.

Therefore an engineer entering management is not to be sympathized with for having to bid good-by to the practice of a rewarding and satisfying profession to enter into a sterile and insulated existence of administering the work of others. Instead, he is entering into a profession in which he will work with mechanisms which in the true sense are much more real and much more intricate than the mechanical ones he knew—a profession in which the laws are subtler, the responsibilities greater, and the entire outlook more challenging. It is really a happy occasion for him, a matriculation into the highest-ranking graduate school there is, a stimulus to the best kind of study and thinking that his already highly trained mind is capable of.

And if the performance of engineers to date is any guide, the challenge will be well met.

ANALYSIS *of* DEVELOPMENTS *in* AUTOMATION[1]

By C. J. JACOBY, 3RD

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THE concept of automation, or the "automatic factory," has long been forecast—and indeed partially achieved—for high volume production. Much less has been said about automation for the plant which cannot sell half a million identical units each year, yet is faced with similar problems.

There is continuing pressure to reduce the costs of manufacture. High labor, equipment, and facility costs require full utilization of man and machine time. Certainly this is true in metal-removal methods, where competition from new production techniques (such as extrusion, die casting, and powder metallurgy) and from new materials (such as plastics) has led many companies to avoid metal-cutting methods in favor of less costly production techniques where possible. The demands for more accuracy and closer tolerances are increasing. The growing complexity of articles produced today requires smaller limits of error and a more accurate reproduction of the original design concept.

Some of these problems have been resolved and lower unit costs have been achieved by the use of special machines built for the sole purpose of producing a single part in large numbers with a minimum of human control. The inherent lack of flexibility of such machines is not objectionable where product design is changed infrequently; but it precludes their use for low quantity production.

THE CONCEPT OF PROGRAMMING

Programming—the direction of a mechanism through a desired operating cycle—is the term given to a development which makes possible automatically controlled general-purpose machines. This particular usage of the term may be new, but the concept is age-old. Man's mind constantly programs his every action. In picking up a pencil, for example, the mind programs the movement of the hand into position, the opening of the fingers, the closing of the fingers about the pencil, and the movement of hand and pencil into the desired position. Most machine-tool operations still utilize the human mind to perform the programming function, whether the operator reads a blueprint and determines methods, feeds, speeds, and so on, or is aided by instruction sheets and machine set ups performed by others.

Through the use of mechanical aids such as templates, cams, limit switches, and the like, the programming of the cutting-tool travel does not have to be done by the human operator. The mechanical aid takes over that function, but the operator must still be there to load, set feeds and speeds, and to set up the mechanical aids. The use of such mechanical aids has been developed in the transfer-type machine so that no human programming must be done at all. However, the programming is built into the machine and the program cannot be changed to produce a different product without substantial time being taken to change the controlling elements.

The lack of flexibility in such a machine can be overcome by utilizing programming information from some external source, which is fed into the machine tool to control the operation automatically. The same machine could be utilized to produce automatically a different part, by merely changing the inflow of information. This concept of external programming has been used before in other applications; for example, the Jacquard loom, or the old-fashioned player piano in which a wide roll of punched tape controls the keys of the piano to produce the desired result—music.

DESCRIPTION OF PROGRAM-CONTROLLED MILLING MACHINE

Several different types of externally programmed machines, similar in principle to the player piano, have been designed and actually built. In all of these, information is somehow recorded in a form which can be interpreted by a control which directs the operation of the machine. For purposes of illustration, consider a Cincinnati Hydrotel vertical-spindle milling machine, which has been adapted to program control by the Servo-Mechanisms Laboratory of the Massachusetts Institute of Technology. This control has the ability to co-ordinate tool motion along each of three axes. The shape to be cut is defined by a series of points in space and the cutting tool is directed from one point to the next point at the desired feed rate by means of information stored on a punched tape. These points may be as close together as 0.0005 in. or as far apart as 60 in.

The direction of the cutting tool by servomechanisms insures that the actual position of the cutting tool corresponds at all times with the instructed position. Thus with co-ordinated control of three axes of motion, it is possible to approximate any desired shape—a circle, an irregular path, or a straight line—while the control of the time from point to point permits control of the rate of feed at all times.

The preparation of the tape requires the analysis of the part to be produced and determination of the various tools and cutting feeds to be used, as must be done in setting up a standard machine tool. The best path of the cutting tool is then determined, and the points and cutting rates must be translated into co-ordinate axis positions and times, and the tape punched. This can be systematized and performed by clerical help.

A simplified control could be made for use in controlling motion in only two axes. For instance, a lathe could be controlled so that one roughing cut could be taken on a multi-diameter, irregular-shaped piece, with each diameter cut at the optimum rate of metal removal; or, the workpiece in a complex drilling operation could be located accurately, a hole drilled, and so on, through a series of drilling operations. Information directing indexing or changing of drill bits could be recorded on the control tape.

ADVANTAGES OF PROGRAMMING CONTROLS

The most obvious use of such a control lies in the production

[1] This paper is abstracted from a report entitled "Machine Controls That Remember," by D. R. Aufderheide, D. W. Brown, R. B. Keller, P. L. Nies, G. P. Tanquary, and the author, prepared in partial fulfillment of the requirements of the course in "Manufacturing."

Contributed by the Production Engineering Division and presented at the Semi-Annual Meeting, Cincinnati, Ohio, June 15–19, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

of accurate complex shapes. The movement along each axis is punched step by step in the tape when it is made, but the machine when controlled by the tape operates at the desired cutting rate. This results in a minimum of human error and products of uniform quality. There is no need to make a cut, measure, and make another cut, until the desired size is achieved. This is recorded on the tape, and the cutting tool is moved to that position with an accuracy of plus or minus 0.0005 in.

The point of actual cutting is determined by the diameter of the cutting tool and it must be considered when making the tape. This requires the use of the correct-size tool if accurate reproduction is to be obtained. Tool wear will change the diameter and thus will introduce inaccuracies. Ordinarily this tool wear would not excessively reduce the accuracy of reproduction, but the worn tool would have to be resharpened and issued to another job requiring the next smaller "standard" size tool.

The application of such controls makes possible higher production per machine hour for simpler operations as well. This occurs through reduction in idle-machine time during setup and in many cases through reduction in machining time. The setup involved in the use of such control comes in the insertion of a properly sharpened cutting tool, the setup of the work-holding device, and the threading of a prepared tape. Without programming controls, the setup involves the same tool change and setup of work-holding device, but in addition requires the alignment of mechanical stops and controls which commonly necessitates trial operations. Programming makes possible the use of automatic control for short runs, while previously it was feasible only for long runs because of the time and cost involved in setups.

The reduction in machining time is possible owing to the more efficient direction of the machine tool by the programming control. The cutting tool moves at the exact rate of cutting feed for each particular part of the operation as determined by the methods analyst. There is no tendency for the control to "slack off" as may be the case with an operator who honestly feels that the required cutting feed is too fast to produce the finish required, or too hard on the machine or the cutting tool. The rate of feed may be adjusted continually over the part, as the amount of metal to be removed and thus the optimum cutting speed varies. This an operator could not do.

Although the use of programming controls may result in increased production per machine hour, an important feature is the reduction of the human attention and skill needed. Since the control of the machine is automatic, the function of the operator is to load, unload, and start the machine. Therefore he is able to operate several machines, and the labor cost per piece is reduced. Furthermore, a skilled machinist is no longer required to operate the machine. This would be a great advantage during the time of shortage of skilled machinists.

The extent of the savings possible depends on the particular parts to be produced. To date, extensive cost investigations have not been made; but analysis of a few parts—chosen to be typical of machine-shop operations—indicates that substantial savings are possible. Savings are valid only in relation to the cost of the improvement. Since no programming control has yet been used commercially, any cost estimate is necessarily vague. However, the project engineers at M.I.T. estimate that their control could be produced and installed at a price roughly comparable to that of the machine it would control. There is no doubt that initial capital outlay for programming controls will be large. Yet, the increased productivity per machine-hour quite conceivably could result in the same or even less capital investment per unit of output.

PROGRAMMING CONTROLS AND GENERAL-PURPOSE MACHINES

The introduction of programming will accelerate trends already apparent in the structure of business. The role of the maintenance man becomes increasingly important since programming controls are complex instruments. The preparation of the tape, although final computations and actual preparation are routine and may be performed by clerical personnel, will require methods men skilled in the use of programming controls; and their function will be even more important to effective operation than at present. The engineering department will have to be more closely co-ordinated with production, as the design of a part will influence greatly its adaptability to programming controls.

The flexibility of the control combined with its productive efficiency would economically permit a more varied product line. This would make it possible for the sales department to have a wider line to sell. Yet, with semiskilled or unskilled personnel doing the machining, production costs become less important in the over-all cost of the product and the fixed or overhead costs become larger. Overhead costs, at best, are difficult to control, and have a strong effect on the profitability of a plant in terms of varying volume conditions. The features of automaticity facilitate scheduling of production as well as more rapid production. Work-in-process inventories can be smaller and will move through the plant more rapidly. The reduced inspection required means the parts will be waiting less time for inspection.

Thus the programming controls make available to the job shop some of the advantages of the production line in the decreased work-in-process, the use of less skilled people, easier and more certain scheduling, and the time for an operation being controlled mechanically. Yet this is possible without losing the flexibility of the general-purpose machine. The combination of programming controls and general-purpose machines can even make the machine more flexible in that it can perform operations not possible without the control.

For example, consider a retaining ring which must have bolt-holes accurately drilled and the inside circumference of the ring machined. Ordinarily this would be drilled and then the circumference turned on a lathe. A vertical-spindle milling machine controlled by programming could first drill the holes accurately and then with the substitution of a milling cutter mill the inside circumference accurately. Since the part has not been moved, the two operations will be located precisely in reference to each other—a problem sometimes rather difficult and very important to achieve. Furthermore, one loading operation has been eliminated. The programming control conceivably could be utilized to change or index the cutting tools automatically, and the operator would only have to load and push the start button.

PROGRAMMING CONTROLS AND AUTOMATION

This paper has discussed the advantages of programming controls in achieving automaticity for general-purpose machinery. Can the same controls be used to operate loading, positioning, and conveyers joining the machines to achieve automation? Technically, the answer is, definitely, yes!

It would not be feasible to use the mechanical types of automation for the production of several different products, similar in size and shape and going through a similar sequence of operations, as the volume of production of each product could not absorb the necessary set-up cost. At present, each of the operations would have to be done on a separate machine, the parts moved between machines in lots, and the machines operated by machinists. Programming controls applied to

(*Continued on page 828*)

The ROMANCE *of* POWER *and* FUELS

By J. E. TOBEY

PRESIDENT, APPALACHIAN COALS, INCORPORATED, CINCINNATI OHIO. FELLOW ASME

THE part played by fuels and power is an indispensable corollary to the romance of fabulous America. Our country as we know it could not exist separate and apart from the atmosphere made possible by plentiful power and fuels. Our strength, our future, our comfort, and the heritage which we must hope to leave to our posterity, are dependent upon these important factors.

It may surprise the reader to know that this force which makes America strong, frequently thought of as intangible, can be reduced to tangible terms and expressed in a formula. It then becomes the most important formula to man's welfare in all the world.

While this formula is not very well known or understood, it is the only way to maintain a high industrial standard of living. Its effect on the wealth of nations and people outstrips the significance of the formula for splitting the atom or for the rearrangement of molecules in any complicated chemical process. Simply stated, it is a formula by which man increases his physical strength by tens, or hundreds, or thousands of times, and is sometimes stated as follows: Natural resources, plus human energy, multiplied by tools, equals man's material welfare, or (NR + HE × T = MMW).[1] An examination of this concise formula reveals clearly the easiest and sometimes the only way to increase the living scale of a people. Man's material welfare may be added to by finding new natural resources, or it may be increased to some extent by harder work, but it can only be multiplied by increasing the supply and efficiency of existing tools. Classified as tools under this indispensable formula is every type of mechanical aid to human strength ranging from the ordinary claw hammer to a million-pound boiler powering a mammoth steam-electric generator.

The economic history of mankind is largely a study of the development, use, and control of the tools which have resulted in today's tremendous productivity and industrial empires. And, the significant fact is, these tools must be powered. Our mineral fuel supply is drawn upon to provide the needed energy. Nature generously distributed the vast deposits of these fossil fuels near the surface throughout large areas in this land of ours, and for good measure threw in hundreds of potential water-power sites.

Another great asset, and one which supplies the second element in the formula, human energy, is found in the driving power, vigor, and character of the early settlers of America. These people came to America driven by the strong urge to live as free men, to worship God according to the dictates of their own consciences, to earn their livelihood by pursuits of their own selection, and to throw off the yoke of many old-world restrictions. Thus they came to the new world with free minds and hearts, and with a spirit of adventure, the like of which the world has never seen before or since.

This spirit of adventure and the will to work is the catalyst which has led to the great discoveries and development of tools for the use of energy which has made America the greatest industrial nation, and the most prosperous nation on the face of the earth. It was these people who established the new type of education system which was tuned to industrial and scientific development. This system gave all American youth an opportunity to acquire a basic education, regardless of circumstance of birth. It resulted in a much greater percentage of the youth of this country receiving such education than is afforded those of almost any other nation.

This accelerated America's progress because it led to the discovery and training of many more intelligent minds than the old-world system could have produced. For a hundred years, our universities and colleges have been turning out engineers whose minds were trained in an atmosphere of democratic freedom, in which they were encouraged to use their imagination and initiative to the fullest extent. In this period, tens of thousands of engineers have entered the professional field.

The resulting spirit of adventure and achievement is by no means limited to college men and women. In fact, it pervades the very air in America. In the great American saga, everyone knows of the outstanding contributions made to America's progress, engineering and otherwise, by countless people including the geniuses Edison, Ford, Carnegie, and Burbank, who did not have the benefit of college training. The productivity of this fabulous America which we see in the form of airplanes, automobiles, air conditioners, radios, televisions, refrigerators, automatic washers and driers, small appliances, and furniture, are only manifestations of the power behind the throne, which is the conversion of tremendous quantities of energy.

ELECTRIC POWER HAS CHANGED THE WORLD[2]

No greater romance can be found than in the unprecedented development of electric energy in the United States. Electricity is the greatest tool in our formula for man's material welfare.

Electric power is the genie which paces the progress of America; in fact, all progress is in some way geared to it and the "kilowatthour" is more stable today than the American dollar.

Space limitations preclude a comprehensive description of the electric power industry—the number-one growth industry which has been created in less than one hundred years.

The background to modern electricity began in England in 1709 when Hauksbee built a spark machine. In France, followed Du Fay who discovered there were two kinds of electricity. Unlike kinds attract each other but like kinds repel each other.

In 1745, there came from the University of Leyden, in Holland, the first primitive condenser or storage battery, the Leyden jar.

[1] The formula concerning human energy and tools has been widely publicized by Dr. Willfred I. King, Professor Emeritus of New York University.

Banquet address presented at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Cincinnati, Ohio, June 18, 1952.

[2] Background data furnished by McGraw Hill & Company, and Sherman H. Dryer Productions, New York, N. Y.

Franklin proved that lightning and earthy electricity are the same.

These men all worked with static electricity. Then came a group of men who studied current or the movement of electricity.

The Italians Galvani and Volta worked with conductors, and the latter explained the flow of electricity.

Oersted in Denmark made discoveries in the field of magnetism.

Ampere in France made important contributions with respect to the characteristics of electric currents.

Others proved that the cycle pertaining to electricity and magnetism was reversible and either could produce the other.

This was the last link in the chain which made possible Faraday's invention of a machine to produce steady current.

In point of time these were fast-moving events, requiring about 170 years to discover the fundamentals of electricity necessary to design and build the first commercial electric generators.

And here is where the Americans came onto the scene. From 1876 on, came the great contributions by Alexander Graham Bell, Thomas A. Edison, George Westinghouse, Nicola Tesla, and Samuel Insull, and such manufacturing concerns as Allis-Chalmers, Babcock and Wilcox, Combustion Engineering-Superheater, Foster-Wheeler, General Electric, Riley, Sprague Electric, Western Electric, Westinghouse, and many more. Then the Edison Electric utility companies were organized to make and sell power, such as Consolidated Edison (N. Y.), Commonwealth Edison (Chicago), Detroit Edison, and many others throughout the country.

Water-power sites also were developed for electric generation. Today, power is generated throughout the length and breadth of America by nearly 4000 electric utilities, including privately and publicly owned concerns.

Today, every American has at his bidding the energy equivalent to 200 slaves in electricity and other forms of energy. In fact, it would require the energy output of 30 billion slaves, a number greatly exceeding the population of the world, to equal the energy supplied by mineral fuels in the United States alone. A most important form of that energy is electricity. And further, electricity can do many things which human beings cannot do.

Great names of engineers associated with the development of the power industry include among others, W. L. Abbott, Irving Moultrop, John Anderson, E. B. Ricketts, E. H. Tenney, Ernest Hopping, C. W. DeForrest, Walker Cisler, Philip Sporn, John Lieb, Orrok, Hirshfeld, and D. S. Brown.

Among the manufacturers of steam-generating equipment and automatic controls, who are responsible for the technical development of modern power-plant equipment, are the names of great engineers including E. G. Bailey, Kreisinger, Smoot, VanBrunt, Craig, and Frisch.

Always working in liaison between the utilities and the equipment manufacturers in the design of power stations are the consulting engineers including such famous firms as Stone & Webster, Sargent & Lundy, Ebasco, Burns & Roe.

Commercial electric generation began in 1882, at the Pearl Street Station in New York City. Generating capacity has multiplied 7 times in the past 25 years.

The installed capacity in 1952, is 81,065,575 kw. It is estimated that this will be increased to approximately 98,000,000 kw by 1954, and that it should exceed 100,000,000 kw by 1955.

Today so great is the rate of expansion of the electric power industry that scarcely a month goes by without the addition and dedication of new power stations or additional facilities of existing stations. Typical was the dedication on June 11, 1952, of the Walter Beckjord Station of the Cincinnati Gas & Electric Company, named in honor of the company's President, Walter C. Beckjord, an outstanding engineer and one of the most successful administrators in the utility industry. This station ultimately will have a capacity of 1,000,000 kw. Attesting the sound financial position of this company is its record of dividends. The company's dividend payments on its common stock began in 1853, and have been continued without interruption to the present time, a period of 98 years. With the single exception of the Pennsylvania Railroad, this is the longest record of continuous dividend payments of all the companies listed on the New York Stock Exchange.

Practically all electric power utilities are facing large expansion programs and their future is bright. Their record of achievement and performance is outstanding. The character of the men behind this industry and allied industries is reflected in the roster of names previously mentioned. No industry offers a greater challenge to its executives, engineers, and the men and women in its lower ranks.

Truly this industry is a fine example of the romance of big business.

THE FUEL INDUSTRIES

The major fuel industries—petroleum and coal—differ widely in contrast to the power industry with respect to the number of companies involved in the production and wholesaling of their products. In the case of petroleum, the industry is made up basically of a much smaller number of companies than that of electric utilities, whereas the coal industry consists of a great many more companies than the utility industry.

The relative position of the fuels in the total energy picture changes constantly. Within the memory of most of us, coal once had a monopoly with only wood fuel as a competitor. Then came the fluid fuels—oil and natural gas—in increasing amounts so that by 1951, the production ratio of the fuels was 39 per cent coal; 42 per cent petroleum; and 19 per cent natural gas.

It is worth while to call attention to the fact that perhaps contrary to general belief, the impact of the fluid fuels has not reduced the annual production of coal. As a matter of fact, coal production for the past 50 years has shown a consistent increase. Bituminous and anthracite production combined averaged 517,250,000 tons from 1900–1952. The average production for the past 15 years—1937–1951—of bituminous and anthracite combined was 572,000,000 tons. The average for the past 5 years—from 1946–1951—was approximately 590,000,000 tons. It can be seen from these figures that total coal has not lost ground. Losses in one category have been made up in another.

Fluid fuels have secured volume somewhat on the order of the increase in population. The total energy supply of the nation has increased about 75 per cent in the past 25 years. Most of the increase has been supplied by fluid fuels.

In the matter of fuel reserves, coal is of course in the most favorable position with over 92 per cent of the known mineral reserves in the United States. Oil shale is next in importance, with oil and gas a minor portion of the remainder. There is no argument here as the petroleum, natural gas, chemical, and coal industries are seriously involved in studies and plans for supplementing supplies with synthetic oil, gas, and chemicals to be made from coal.

PETROLEUM INDUSTRY

The fabulous story of oil has been widely treated in fiction, legend, and in scientific and factual articles and books. The movies have played it up, and prospecting for "Black Gold" has been glamorized in every form of public communication. In fact, as a coal man, I might say that the oil industry has ob-

tained more free publicity than any industry I know, until in the public eye, the industry is regarded as synonymous with progress and growth. As a matter of fact, the fair-minded person must admit that is true to a large extent. Furthermore, the present state of good public relations represents a great expenditure of time and money following the monopoly scandals and public condemnation coincident with the early founding of John D. Rockefeller's oil empire.

But the oil industry has grown up. The National City Bank of New York City publishes a monthly letter on economic conditions. The June, 1952, issue listed the 100 largest industrial companies in the United States, based upon their total assets at the end of 1951. Out of these 100 companies, 20 were oil companies. No other industry was so well represented.

The companies on the list of 100 largest employed about 42,000 workers per company, and the investment per worker in the petroleum industry amounted to around $37,000. These 20 oil companies alone recorded total assets at the year end of nearly $20 billion.

Producing less than 1 billion barrels of crude oil in the year 1935, by 1948, the U. S. oil industry had exceeded 2 billion barrels, equivalent to about 500,000,000 tons of coal. This compares with 599,518,229 tons of coal produced the same year. Just before the last strike, annual output was running at the rate of nearly 2.3 billion barrels a year.

This industry drills around 40,000 wells a year, has 450,000 wells in constant production of crude oil, owns over 125,000 miles of pipe lines in operation, and ends up by drillingan a verage of 5000 miles of exploratory dry holes each year in search for more "Black Gold." Wildcat drilling has one chance in nine to succeed, as eight out of every nine exploratory wells are unsuccessful.

From 3 miles below the earth's surface, oil is being produced and distributed. Twenty-six states contribute to oil production with Texas producing roughly 40 per cent of the total, and California nearly 20 per cent. Louisiana, Oklahoma, and Kansas follow closely in that order. As crude oil, before being refined, this has an annual value of approximately $6 billion. Refining of course adds tremendously to its value. In the oil industry the hourly wage rate is $2.05, while hours worked per week average 42; and in the coal industry the hourly wage rate is $2.24, with hours worked averaging 35.

Nearly 450,000 workers, according to the Bureau of Labor Statistics, are employed in petroleum-refining and crude-oil and natural-gas production. According to the most recent figures, the annual wage bill amounted to nearly $2 billion.

Between 10 and 15 per cent of our total oil supply is imported. Another half-billion barrels a year travel by tanker from the Gulf to the East Coast of the United States. Some of the most dramatic stories of World War II had their setting in the submarine action against this trade, and the threat to our oil supply by modern snorkel-type and atomic-powered submarines is a major concern of defense planning right today.

Twenty-five of the largest crude-oil producers account for over $^3/_4$ of the country's crude oil output, and twenty-five of the largest refineries account for about $^7/_8$ of the country's refined products.

The petroleum industry is the fourth largest in the American economy in terms of capital investment, exceeded only by agriculture, railroads, and the combined divisions of the public-utility field. In 1950, the petroleum industry was a $30 billion operation, $23.5 billion of it invested in property, plant, and equipment. All told, including production and distribution, it employed about 1,800,000 people.

Refineries account for about $^1/_4$ of the total oil-industry investment. There are about 375 refineries operating today, before the recent strike, at around 93 per cent capacity.

The only unqualified statement that can be made in connection with the continuing and ever-widening search for oil is the one attributed to an old prospector when asked for his success formula; he replied, "Oil is where you find it."

Thus while modern geology and advanced techniques and equipment have tended to reduce the hazards of search, when all is said and done oil is still where you find it; and conversely, even though the prospector follows the latest scientific methods and uses the latest equipment and techniques, oil may not be found where by all measures and on the basis of all previous experiences, it should exist.

Because of such hazardous conditions, never-ending credit must go to the men whose dreams, determination, and persistence make possible the continuing supply of oil for America's ever-growing needs. Wildcatting, as such, remains one of the prime speculations in the modern age. The real honest-to-goodness wildcatter, frequently having only a beat-up rig, held together by a shoestring, substitutes persistence, inspiration, and an undying ambition for up-to-date equipment and financial resources. Fifty, or seventy-five, or one hundred dry holes in succession dissuade him not; he is just as convinced as he was at the beginning that the next effort will bring oil gushing skyward to give him henceforth and forevermore a life of ease and wealth and influence for all to see and observe. And sometimes, often enough to keep alive the spark in the breasts of adventuresome souls, it happens just that way. America can be grateful for these oil pioneers who have maintained the oil supply in a manner thought to be impossible a generation ago.

HOW IMPORTANT IS COAL?

What is the bituminous coal industry? Basically, it consists of the following: 9000 mines in 28 states; 5000 operating companies; plant value approximately $3,000,000,000; gross value of coal produced at the mines (1951), approximately $2,750,000,000; annual potential mining capacity approximately 700,000,000 tons; annual production (1951), 535,000,000 tons; annual wage bill exceeds $1,500,000,000; annual purchase of supplies, equipment, and repair parts exceeds $500,000,000; number of miners, approximately 370,000; average production rate (1950), 6.95 tons per man-day (highest rate in the world).

In the anthracite industry, there are 98 producing companies; 170 mines; 41,340,000 tons produced in 1951; gross value of coal produced in 1949, $358,008,451 f.o.b. shipping point; annual wage bill, $230,000,000; number of miners, 65,000 (1951-1952); production rate in 1949, 2.87 tons per man day.

Of all the commodities produced in our country, coal is by far the largest in physical volume. The annual tonnage of coal produced is approximately 4 times the tonnage of all our grain crops, including corn, rye, wheat, barley, and other grains. It is 200 times the tonnage of our cotton crop. It is more than 6 times the tonnage of our iron-ore production. In annual dollar value, it is more than the value of all the iron ore, gold, silver, nickel, zinc, lead, and other nonferrous metals produced in the United States.

In 1951, coal heated one third of the nation's homes, generated half its electricity, provided the heat and energy for a great part of its factories, and performed many other tasks. But that was not all. Coal in 1951, and every year, is the basic ingredient for a thousand and one wonders of industrial chemistry which make our industrialized civilization possible and more comfortable. Perhaps greatest of all its manifold uses, coal makes possible every machine and every convenience of a steel-age civilization, for coal, as well as iron ore, is a parent of steel.

It is this latter fact that prompted Lloyd George to say in the dark days of World War I: "In peace and in war, King Coal is the paramount lord of industry. It enters into every article of consumption and utility." In the dark days of World War II,

Winston Churchill, speaking on October 31, 1942, to miners and mine operators, declared: "War is made with steel and steel is made from coal. Coal is the foundation and, to a very large extent, the measure of our whole war effort."

America's coal requirements, whether peacetime or emergency, are so great that mechanized mining is the rule. Over 90 per cent of our underground production is machine cut and about 70 per cent is machine-loaded.

In fact, mechanization has reached the point where several types of so-called "continuous miners" are now on the market. These machines combine in one unit the features of three or four of the machines now performing separate operations. Such a "continuous" mining machine moves like a military tank, ripping coal from seams with special cutting devices and depositing it on a self-contained conveyer which loads mine cars following the machine. Employment of such amazing machines, which produce several tons of coal a minute, eliminates the "cyclic" method of mining which uses a cutting machine, drilling machine, blasting device, and loading machine in turn.

Last year the railroads moved about 400 million tons or as much as 2 million tons per day. To do this job required the use of 700,000 hopper and gondola cars and the movement of over 30,000 carloads of coal a day; and the return of 30,000 empty cars a day. This is the greatest logistics job in the world.

Two hundred and twenty large coal mines have been opened or placed in development in the past 5 years, each with a daily capacity of 500 tons or more. Some of these mines cost as much as $10,000,000. About 800 smaller mines have been opened, too. This is new growth; these are new risks, new ventures.

Of far greater importance than the foregoing statistics and facts is the character of the men responsible for the development of this great basic industry; basic because coal undergirds the total industrial development of the United States. All other industries are beholden to coal in more than one respect; however, one serves to well illustrate this fact; every industry in America depends on steel and coal is one of the parents of steel.

Back of the development of each of the many thousands of mines is the shadow of a stalwart man, possessing the spirit of a pioneer, driven by an insatiable urge to search, discover, and exploit the great coal reserves of the nation. This man is a type of individual who possesses a rugged character, who finds great satisfaction in overcoming almost insurmountable obstacles requiring physical stamina, initiative, and a business sense to handle the mechanical and financial problems incidental to handling an important business enterprise. These problems would discourage many a less hardy individual.

Every citizen in America owes much to this man who is still a pioneer scouting for minable coal deposits. All of us depend on this man to discover and develop new sources of supply to make up for the exhaustion of old mines as well as the increase in demand for this most essential source of energy.

As an example of the rugged terrain from which comes some of the country's finest coal, let us go to the city of Harlan, Kentucky. Radiating from Harlan are five river forks which flow into the Cumberland River. In these five river valleys there is found what is probably the greatest concentration of mines—many of them small—in the entire coal industry. If we think of this particular development as represented by the human hand with the town of Harlan as the palm and each one of the five forks of the Cumberland River representing one of the fingers of the hand, from the palm of which to the tip of the finger equals 20 miles, we could—if such a trip were possible—start from the tip of the thumb, go into the valley and over the mountain, into the valley and over the mountain, and finally land at the tip of the little finger with an elapsed distance of only 15 miles. While in actuality, to develop this territory it becomes necessary, again starting at the palm of the hand and using modern modes of transportation, to travel up and down, up and down each valley until we have contacted each of the five points. This necessitates traveling in excess of 200 miles.

This well serves to indicate obstacles to be overcome and the costs involved in winning from these areas the high-quality coals which industry demands.

FUTURE OF THE FUELS

One of the romantic dreams in connection with the future fuel supply we must mention in passing. It has been given some substance by the news of a submarine powered with atomic energy, and the plans to propel aircraft in the same manner. This has raised the question of the ultimate place of atomic energy in our industrial system.

Naturally, no one is able to predict accurately the development of this, the greatest scientific discovery of the twentieth century, but I do know that at present, and for a long time to come, we shall probably put as much energy into atomic projects in the form of coal, or other mineral fuels, as we take out in the form of atomic energy.

That is the story of atomic energy at the moment. As to the future, I can do no better than quote Gordon Dean, Chairman of the Atomic Energy Commission, who recently said, "Atomic energy will tend to supplement, rather than to supplant other sources of fuel supply, for at least as long as the traditional fuels are available at relatively low cost."

From the practical standpoint, before atomic energy can have widespread use, there is still a long long way to go in technical research and development.

The prospects then are that the fuel load will continue to be carried by the fossil fuels—coal, oil, and natural gas. The rapidly expanding per-capita energy demand by 1975, will call for at least double the present output of these traditional fuels. The form of this demand will mean an increased supply of fluid fuels, and fuel economists and technicians expect that well over 100 million tons of coal will be synthesized by 1975, to help meet this demand, in the form of synthetic oil or synthetic gas. In fact, the demand for bituminous coal by 1975, may reach one billion tons. Three hundred and fifty million tons of this will be used by the electric utilities, over 200 million tons by the steel and by-product industries, with synthesis, exports, domestic space heating, and general industrial demand accounting for the difference.

Nor is this the end of the story. By every logical calculation, the maximum production will have been obtained by 1975, from known and projected oil and gas reserves. From that time forward the load must fall increasingly on bituminous coal. This was recognized by Mr. Eugene Ayres of the Gulf Oil Company in his recent book "Energy Sources—the Wealth of the World," when he looked forward to 2 billion tons of bituminous coal annually by the end of the present century.

CONCLUSION

In speaking about the power and fuel industries, I have tried to go behind the scenes to show how the progress of the nation and its high standards depend so greatly on these industries. In highlighting the salient features of these great industries, in looking for a moment at the romance of power and fuels, it is significant to note that the important features are not all physical and material things; but that topping the list are the men who run these great enterprises. It is the character, skill, and resourcefulness of these executives and pioneers—a high percentage of whom are engineers—that have made the great "Miracle of America" possible.

These great men, operating in the new-world atmosphere of freedom, have made possible the strength and leadership of America, and the continued liberty of her people.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Space Travel

THE first steps in man's conquest of space are now being planned seriously and systematically by a number of rocket engineers, according to the July, 1952, *Industrial Bulletin* of Arthur D. Little, Inc., Cambridge, Mass. These experts agree that the development of a space ship which would travel regularly in a fixed orbit around the earth is both desirable and possible. Such a man-made satellite could function as a research laboratory, as a military observation post, and as a way-station for eventual space travel. In the long run, a space station would probably be more valuable in research than as a weapon, although the military would probably be responsible for most of its development. While there are still many problems to be solved such as those of improved construction materials and smaller control equipment, much work has already been done on propellants and rocket engines, and present discussions are based on engineering phases of the operation. Among the rocket engineers, however, there are differences of opinion on the cost and time required to carry out such a venture, the *Bulletin* states.

Dr Wernher von Braun, a leader in the development of the German V-2 rocket and currently technical director of the Guided Missiles Development Group of the U. S. Army Ordnance's Redstone Arsenal, is the leading proponent of a permanent, manned satellite space station to circle the earth every two hours at an altitude of 1075 miles. This space station could be constructed in ten years, according to Dr. von Braun, at a cost of $4 billion, including the development and testing program. The station would be constructed by lifting men and materials to the orbit in giant supply rockets fueled with nitric acid and hydrazine, a chemical which is now rather expensive. These rockets would be three-stage affairs with large wings and fins, to dissipate heat on the return glide. The ship would have a total weight of 7000 tons, and would carry a pay load of 36 tons. One stage of rockets would get the ship off the earth and 24.9 miles into the atmosphere; it would be jettisoned when propellant supplies were consumed. The second stage would provide the power to approach the orbit; the third stage would provide the remainder of the speed required to carry the ship into the orbit and would have a supply of propellant to return to earth. The space station would be built in its orbit, after about a dozen trips of the three-stage supply rockets.

A somewhat less ambitious plan has been suggested by James H. Wyld, noted rocket-engine designer and a founder of the oldest liquid-fuel rocket-engine manufacturing concern in the United States. According to Mr. Wyld, limited space flight is possible at relatively low cost, and will probably precede space-station development. Mr. Wyld's "Model T" space ship has been tentatively designed to circle about the earth at 200 miles altitude. It, too, would be a three-stage affair, but would have an over-all loaded weight of only 12.7 tons, falling off to half a ton after the first stages were dropped. The over-all size of the Wyld ship would be only slightly larger than that of the present V-2 rocket, but it would achieve 17,000 mph, compared with 3500 for the V-2. This extraordinary increase in speed would be attained through special materials, increased motor efficiency, and reduced pay load. Expensive special propellants would not be required; the necessary power could be developed by gasoline and liquid oxygen, costing only a few cents a pound.

The half-ton pay load of this space ship on its first flights would include two scientific observers, their equipment, air supply for two days, a tiny, heat-insulated, pressurized cabin, the third rocket stage, and small wings for landing the cabin at the end of the flight. The two men would have to live in cramped space, with a minimum of food, water, and air for about two days, and would then return to earth. Automatic control equipment would be necessary, especially in descent and landing, when things might happen too fast for the comparatively slow reactions of the space fliers.

Before this type of space ship is successful, there will have to be considerable advances in lightweight structural materials to withstand the extremes of temperature and pressure during descent through the atmosphere. The biggest problem, however, will be "miniaturization" of the intricate control and scientific equipment necessary for space flight. Extremely compact electronic equipment, utilizing printed circuits, transistors, and subminiature tubes, is already available. Recently, also, a

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

line of small batteries has been designed for use with guided missiles, rockets, and similar equipment; these batteries are said to be one third the size and weight of any previously used. Thus the first steps in microinstrumentation for rocket flight have already been taken.

Although these proposals are based on serious engineering estimates, actual operating experience has been slight, the article notes. No high-altitude rocket designed for a safe landing has ever been built. Piloted, rocket-driven aircraft have been flown and landed successfully, but flight times have been only a few minutes and the rocket craft have usually been launched aloft from an airplane.

The first rocket flight will be worth several times its cost, in terms of information obtained. Space offers research tools, such as an almost perfect vacuum and temperatures ranging from that caused by concentration (or focusing) of unobstructed solar radiation down to near absolute zero, all of which would be especially useful to the physical scientist. A space ship in its orbit would permit biological studies of the effects on man and animals of prolonged periods of weightlessness. Astronomers would benefit from photographs of the heavens taken outside the disturbances of the earth's atmosphere.

Probably the most important basic research, however, would be study of primary cosmic rays to provide data for the biggest problem in physics today—the nature of the forces which hold atomic nucleus together. Short-term benefits of such a study might be improvement of processes for producing power from radioactive materials; possible long-range advantages include transmutation of elements to replenish supplies of important minerals. According to one authority, data obtainable from even a short flight of the type proposed by Mr. Wyld would keep physicists busy for years.

Electronic Computer

SUCCESSFUL operation of a new electronic digital computer, designed and constructed by staff members of the University of California Los Alamos Scientific Laboratory, was announced recently by the Laboratory. Called the Maniac (Mathematical Analyzer, Numerical Integrator, and Computer), the new calculator is believed to have distinct advantages over many calculators of earlier design because it is more compact, simpler, and at the same time capable of handling more complex problems than its forerunners.

The Maniac was actually completed, and operation was started, during March. At that time a number of relatively complex problems to which the answers were already known were fed into the machine to test its operation. When the answers turned out by the Maniac were shown to agree with the known answers to the problems, the next step was to feed in more complex problems with several mathematical checks. After this set of mathematical problems was successfully completed, the computer was put to work on some even more complex physics problems to which only the general order of answers was known, and it wasn't until after these had been successfully completed that the scientists responsible for the Maniac were willing to state positively that their machine was successful and ready to be put to work on the Laboratory program. Because of its complexity and the number of new and untried features in its design, the builders of the Maniac are pleased that the computer is successfully solving important and complicated problems so soon after its construction was completed.

While its designers believe the Maniac has many advantages over earlier types of machines, they point out that a number of the ideas used in constructing the Maniac originated at other laboratories. For example, the idea of an electrostatic "memory" is due to Prof. F. C. Williams of Manchester, England. He used 6-in. oscilloscope tubes, operated one at a time, while the Maniac used 2-in. tubes and 40 are operated in concert, thus making for much faster arithmetic operations. Also, there is a computer similar to the Maniac in the early stages of operation at the Institute for Advanced Study at Princeton, N. J., and another similar machine, the Ordvac, has been built by the University of Illinois for the Ballistic Research Laboratory at Aberdeen, Md.

The designers of the Maniac say that it can work approximately 100,000 times as fast as a trained computer using a desk calculating machine. In spite of this speed, some of the problems which it will be expected to solve are so complex that the Maniac will take 20 hours or more to solve a single problem. Later additions to the Maniac, such as an additional magnetic-drum memory and a photoelectric tape reader, are expected to increase both the speed and the capacity of the machine by factors of ten.

One of the interesting abilities of a machine such as the Maniac is that it can make its own decisions in many cases. That is to say, it can choose between two or more methods or sequences of calculation on the basis of results previously obtained in a problem.

Another interesting feature of the Maniac is its compactness. The principal unit of the computer takes up a space only $12 \times 2^1/_2 \times 6$ ft. In addition, there is one machine approximately the size of a standard teletype machine and two additional small units about the size of portable typewriters. These last three units are used for inserting instructions and numbers into the Maniac and also for printing answers.

The Maniac, like most modern digital computers, uses the binary arithmetical system as opposed to the standard decimal system. In the binary system, there are only two digits, zero and one. At first glance it would appear that the operation of the Maniac would require that an individual learn an entirely new system of arithmetic. Fortunately, however, this is not true, because the Maniac and its accessory coding machines can take problems set up in the standard decimal system, transpose the units in the problems to the binary system, solve the problems in terms of binary-system units, and then retranspose the final results back to the decimal system. Thus the casual observer might never suspect that the ordinary decimal system wasn't used.

To give an example of the speed with which the machine can operate—it can feed a number into its memory in as little as eight millionths of a second for retention until it is required for use at a later time. When the number is required later, it can withdraw it from the memory in the same time. Most of the earlier computing machines performed operations in thousandths of seconds, instead of the millionths in which the Maniac operates. The memory of the Maniac, which is one of the keys to its speed of operation and capacity, consists of 40 two-inch cathode-ray tubes which can store a total of 1024 twelve-digit decimal numbers and their signs.

Another advantageous feature of the new machine is the simplicity with which it can be shifted from one type of problem to another. On many earlier types of machines, switching from one general type of problem to another was done in a matter of hours or sometimes even of days. The Maniac, on the other hand, can be switched in a matter of minutes from one type of problem to any other which the machine can handle.

Part of the reduction in size of the Maniac has been achieved by keeping to a minimum the number of electronic tubes which are used in it. For example, the Eniac has 18,000 tubes, while the Maniac has only 3000. At first it might seem that such a vast number of tubes would be a source of trouble, but opera-

tions so far indicate that tubes which are thoroughly inspected and checked beforehand fail infrequently enough to allow very high operating efficiency.

Hydraulic Press and Drawbench

THE nations's largest press for forming boiler drum plate and a method of forming heavy-wall hollow forgings by piercing and drawing an ingot, were demonstrated to the technical press by The Babcock & Wilcox Company at its Boiler Division plant in Barberton, Ohio, on July 22.

The new press and drawbench, built and installed by the company, will produce a rough hollow forging up to 35 in. OD with $4^1/_2$-in. walls, in a matter of minutes. Until now it has been necessary to make such pieces of steel plate rolled and welded at the seam or from a solid forging with the center bored out. These forgings are used mainly for boiler parts and connecting steam lines operating at high temperature and pressure as is the trend today. The press is also equipped with massive bending beams 42 ft long and its open-ended design makes it possible to bend even longer plates.

VERTICAL HYDRAULIC PRESS

The vertical hydraulic press has a normal operation capacity of 6500 tons or an intensified capacity of 8500 tons. The operating pressure is 3000 psi. It has a daylight of 20 ft and an operating stroke of 9 ft 6 in.

The three main cylinders which are 45 in. in diam are weldments, as are the bottom, movable, and top platens which weigh 130, 200, and 115 tons, respectively. The rams which are cast iron are $43^1/_2$ in. in diam and the columns which are 26 in. in diam and 52 ft long are located on 16-ft centers across the face and 14-ft centers fore and aft.

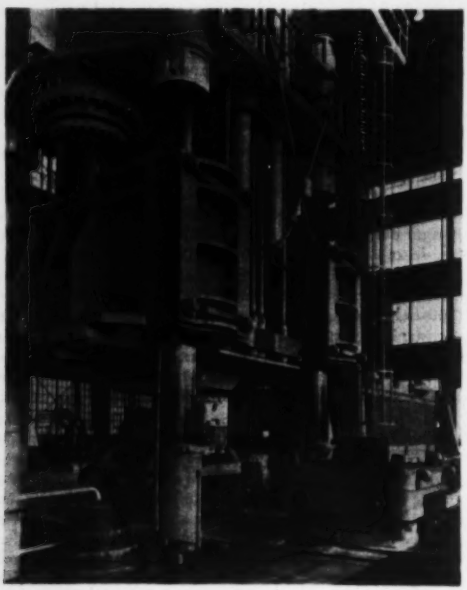


FIG. 1 VERTICAL HYDRAULIC PRESS FOR FORMING BOILER DRUM PLATE AND PIERCING AN OPENING INTO A HEATED INGOT

Two 12-in-diam balancing cylinders are provided as well as two 12-in-diam pull-back cylinders.

Located on the press center and in the pit below the bottom platen is a 500-ton ram 22 in. in diam with a 54-in. stroke which has been provided to pierce a manhole in drum heads. This ram is fitted with two return cylinders. The matrix used for piercing is fitted with an ejector ram with an 8 ft 6 in. stroke actuated by an $11\ ^1/_4$-in-bore cylinder.

Operation with high pressure on only the center cylinder—or on only the two outside cylinders—or on the three cylinders concurrently—has been provided for so that a choice of approximately 2100, 4400, or 6500 tons is available on the downstroke. The downstroke is also safeguarded with a limiting valve which is automatically opened at the 9 ft 6 in. level and dumps the high pressure at this position. To provide greater ease of operation the main hydraulic valve is controlled by an oil cylinder fitted with a servomechanism.

Interlocks have been provided on all separate functions to prevent accidental damage. Maintenance has been simplified by using outside packing on all main cylinders.

When functioning as a piercing press, the heated billet is loaded into the matrix and the stripping plate installed while

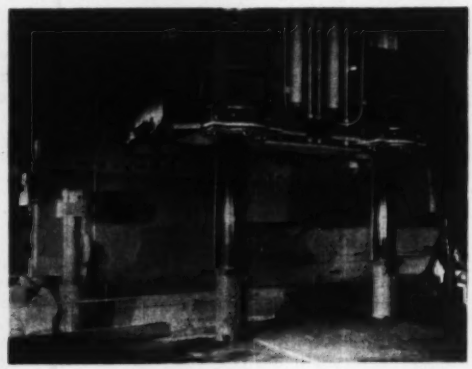


FIG. 2 VERTICAL PRESS IS SHOWN FORMING ONE OF THE HEAVIEST PLATES EVER ROLLED INTO A BOILER DRUM SECTION

the matrix is positioned on a shifting table 14 ft from the center of the press. The loaded matrix is then moved into work position by the shifting table which is moved by a 14-ft-stroke ram actuated by a 9-in-bore cylinder in one direction and two $6^1/_4$-in-bore cylinders in the opposite direction. The weight of the maximum-size billet that can be handled is 26,000 lb. Subsequent to the press-piercing cycle, the shifting table returns the matrix to its former position where the ejection cylinder functions to unload the workpiece. Actuation of the shifting table, the ejector cylinder, and also the 500-ton pit ram is by push-button control.

When the press is utilized for forming drum-shell plates to a predetermined radius, the piercing matrix is moved by the shifting table to a position at the rear of the work area of the press. This leaves an unobstructed space between press columns for the entry of the hydraulically operated plate manipulator which moves the workpiece from its loading position to its work position under the moving platen.

This plate manipulator, which comprises the 42-ft-long lower bending beam, also forms the carriage for cross-travel through the press. It also houses the 16-in-bore hydraulic cylinder which actuates the 52-ft-stroke ram which moves the carriage.

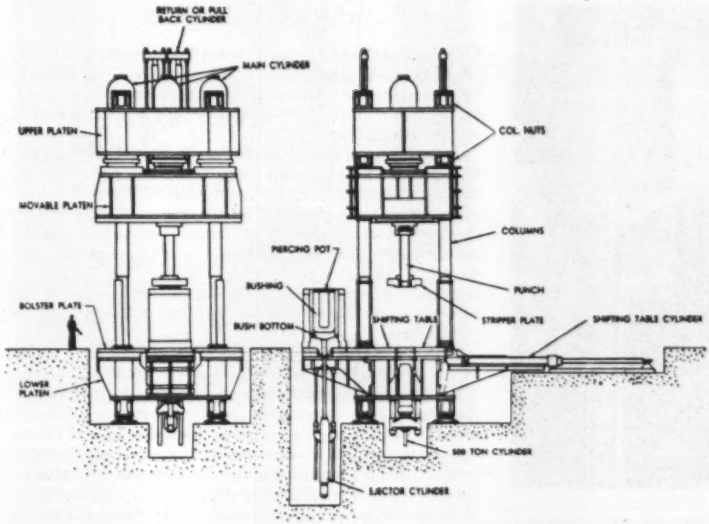


FIG. 3 VERTICAL PRESS SET UP FOR INGOT PIERCING, FIRST STEP IN FORMING A HOLLOW FORGING
(The ingot is placed in the piercing pot, *right*, which slides under the press where it is pierced by the stroke of the ram.)

Storage space for the 100-ton top bending beam has also been provided for in the design of the unit. The assembled weight of the plate manipulator is approximately 350 tons.

Located, two on either side of the carriage, are four hydraulically operated manipulators for handling the workpiece. These manipulators comprise vertical trunnion-mounted cylinders which actuate 6-ft 10-in-stroke rams designed to handle 35 tons each. This permits handling a 50-ton plate with any two manipulators.

The cylinders for each unit are mounted on a carriage that moves in contact with the side of the lower bending beam and also with rails located in the foundation. The carriages are adjustable longitudinally so that they can be spaced from 8 ft to 42 ft apart to handle plates of varying lengths. Angular tilt of the manipulators of approximately 20 deg from vertical to the edge of the beam is accomplished with cross cylinders located on the carriage.

All motions in connection with the manipulator are hydraulically controlled. Movement is instituted by electric push-buttons which energize solenoids which in turn actuate air pilots on the hydraulic-pressure lines. There are six panel-type push-button control stations, multiplied together and strategically located, so that one operator can position the workpiece on the lower bending beam, move it to work position in the press, and also start the forming cycle on the press. The entire control system is safeguarded with interlocks.

The procedure for forming plates is to cold-press in their entirety plates up to about $2^3/_4$ in. in thickness. Heavier plates are first rough-formed while at forging temperature, then finished-formed after they have cooled to room temperature. The same set of dies are used for both cold and hot forming. Plates 45 ft in length can be worked. Over-travel on the manipulator carriage permits locating the workpiece within the limits of the top platen so that heavy and unequal loading of the overhung portion of the 42-ft-long bending beam can be avoided.

A tilt of the movable platen of $^{11}/_{16}$ in. from a horizontal plane, measured at the outer edge of the 25-ft platen, has been provided to compensate for unequal loading of the bending beam when forming plate. This is absorbed by spherical bearings mounted in the column guide bushings in the platen. When not required this tilt is eliminated by hydraulically operated wedges which lock the platen in a true horizontal plane. The rams are hollow stilt type which take the slight amount of side thrust on spherical washers.

During a special demonstration the press formed one of the heaviest pieces of steel plate ever rolled—36 ft long, 10 ft wide, 6 in. thick, and 87,000 lb in weight—into a drum section. The plate was produced by Lukens Steel Company of Coatesville, Pa.

HORIZONTAL DRAWBENCH

The new horizontal drawbench which is utilized for forming hollow forgings has a 1200-ton rating. The return stroke is operated at 600 tons and pressures of either 600 or 1200 tons can be selected for the forward stroke which is 30 ft in length. No other such equipment is said to exist in America today.

The unit has an over-all length of 114 ft and a main cylinder with a 32-in. bore. The main plunger, which is an inside-packed piston type, is $22^1/_2$ in. in diam. The columns on the drawbench are 16 in. in diam with a total length of 84 ft. The die bed is 31 ft 6 in. long with location for die holders along

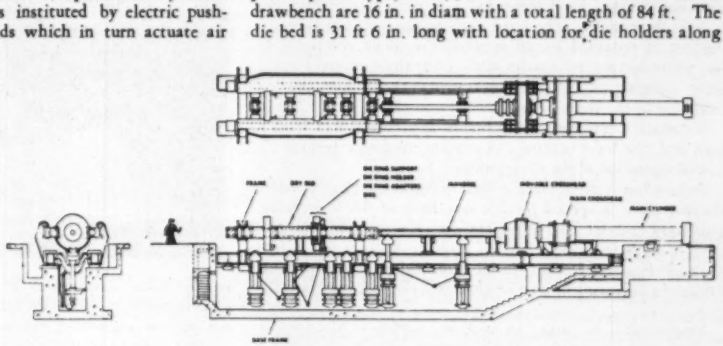


FIG. 4 HORIZONTAL DRAWBENCH

FIG. 5 DRAWING A HOLLOW FORGING ON THE HORIZONTAL DRAWBENCH

(The forging, *foreground*, is forced by the mandrel through a series of ring dies, *center and rear*, to produce a predetermined inside and outside diameter.)

28 ft of length. The unit is equipped with swivel-type die holder and also seven roller supports. These roller supports, which position the mandrel and workpiece, are hydraulically operated with a 25-in. adjustment. The roller supports, which are actually small hydraulic presses, are also push-button-operated and can be shifted lengthwise along the drawbench as required.

After piercing in the vertical press, the hollow forging or bloom, is taken to the horizontal drawbench where it is fitted over the mandrel to hold inside dimensions and the hot bloom is forced through a series of ring dies by the head of the mandrel, reducing the outside diameter and increasing its length, to proper size. The result is a seamless hollow forging of predetermined inside and outside diameter.

The hydropneumatic-pressure system for operating the press and also the drawbench is powered by three triple-piston, single-stage pumps, each geared to a 500-hp 2300-volt synchronous motor. Each pump has a delivery rate of 234 gpm at 3000 lb pressure. The large high-pressure storage capacity required is provided by an accumulator plant composed of two water and five air bottles of the company's normal banded vessel construction. A lubricant is used in the water to prevent oxidation of the working parts.

Automatic operation of the pumps is accomplished with a high and low-level control. A sequencing device permits alternate operation of the three pumps.

To heat heavy drum plate as well as ingots for forging before shaping them, a special furnace was built of B&W firebrick, insulating firebrick, and refractory castables made by the company in its Refractories Division plant at Augusta, Ga. It is 14 × 50 ft and 7 ft high, inside dimensions. An additional furnace for reheating hollow forgings is in the process of installation.

Furthermore, to insure an adequate supply of the special-analysis ingots required for this operation, work has begun on a self-contained melting shop including a new arc furnace.

Boiler Research

THE research and development work being conducted at the Renfrew, England, Laboratories of Babcock & Wilcox, Ltd., as reported in *Engineering*, for June 27, is mainly for boiler design improvement. However, the article notes, much of it is of wider significance.

For example, of four items that can be classed as design developments, the first covers improvements in the design of ultrasonic apparatus for examining welds; the second relates to pressurized combustion, and involves the use of a gas turbine; the third is concerned with the difficulty of making a satisfactory junction between austenitic and ferritic steels; and the fourth, though it will lead to a saving in the weight of superheater elements, is fundamentally a finding of some importance in the design of return bends in pipes subjected to internal pressure.

In the field of measurement there are 13 techniques which may be of value elsewhere. They deal with methods of measuring the following parameters: gas temperature (the method being based on the velocity of sound through the gas); Young's modulus of elasticity (a resonance method which is simply and quickly applied); salts in condensate; thermal fatigue; pressure fatigue; tensile strength at elevated temperatures; bursting strength of tubes under steam pressure; stress analysis of the internal as well as the external surfaces of drums; strength of joints subjected to differential expansion; coal samples; calorific value; fusion temperature of ash; and the viscosity of slag. In the more practical matter of improved methods of construction, studies are being conducted on tube expanding and welding, in addition to the improvent already mentioned, of joining austenitic and ferritic steels. Finally, considering methods of examining or observing, experiments in this connection are being undertaken on corrosion and fouling, and welds, and on the phenomena of combustion and the separation of steam from water.

Cemented Chrome Carbides

THE properties, fabrication methods, and applications for grade 608 chrome carbide, first of the new Series 600 cemented chrome carbides to be made available by Carboloy Department

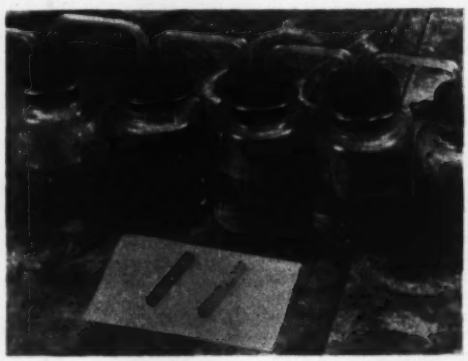


FIG. 6 WHEN EXPOSED TO 50 PER CENT SULPHURIC ACID THE STAINLESS-STEEL SAMPLE (*left*) LOST 7300 MILLIGRAMS OF WEIGHT PER SQUARE DECIMETER PER DAY WHILE THE THE GRADE 608 CHROME CARBIDE (*right*) LOST ONLY 31 MILLIGRAMS PER SQUARE DECIMETER PER DAY

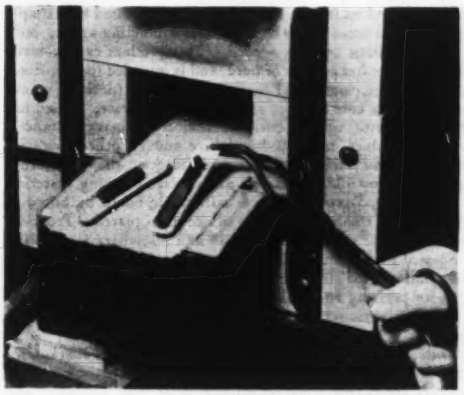


FIG. 7 AFTER EXPOSURE TO AIR FOR 24 HR AT 1850 F, A GRADE 608 CHROME-CARBIDE SAMPLE (*left*) RESISTS ALL OXIDATION BUT THE IDENTICAL STAINLESS-STEEL SAMPLE (*right*) DISINTEGRATES

of General Electric Company, Detroit, Mich., are described in an article by J. D. Kennedy, manager, wear part sales of Carboloy.

The new metal is composed of 83 per cent chrome carbide, 2 per cent tungsten carbide, and 15 per cent nickel. Among its outstanding physical properties are its density, which is about half that of tungsten carbide, and its coefficient of thermal expansion, which approximates that of steel. Actually, tungsten carbide has a thermal expansion coefficient about half that of steel.

Grade 608 chrome carbide is a hard strong metal and resists abrasion much better than hardened steel, according to the article.

Salt-spray tests conducted at Battelle Memorial Institute reveal that Series 600 chrome carbides retain their metallic luster after being subjected to a 30 per cent salt spray for 750 hr.

When subjected to sulphuric acid corrosion tests, Series 600 chrome carbides show 30 times the resistance of 18-8 stainless steels and 3 times the resistance of conventional carbides. Resistance of chrome carbides to nitric acid is 8 times that of other carbides and twice that of 18-8 stainless steel. Chrome carbides are inert when exposed to citric and lactic acids.

The Series 600 chrome carbides resist oxidation at all temperatures up to 1832 F. When subjected to a temperature of 1850 F for 24 hr, samples of chrome carbide are only slightly discolored, while simultaneously exposed samples of stainless steel and tungsten carbide have completely disintegrated.

Steam erosion tests show a resistance for chrome carbides about 50 times that of conventional carbides. Samples $1^1/_2$ in. in diam and 0.250 in. thick were placed $^1/_2$ in. in front of a 350-psi jet of saturated steam passing through a $^1/_{16}$-in-diam nozzle for 25-hr periods.

Four tests of 25 hr each made with different but identical nozzle assemblies show no measurable erosion penetration on the chrome-carbide samples after the first three tests. Maximum average penetration after the first 100 hr is 0.0004 in. These tests show that Series 600 chrome carbides are equivalent to other metals with maximum resistance to steam erosion.

Grade 608 chrome carbide is already available in limited quantities in a variety of shapes for engineering and metallurgical test applications. Production facilities are being expanded to permit delivery of production lots soon.

Because costly and critical tungsten and cobalt are not constituents of Grade 608 chrome carbide, it is expected that complete parts can be economically made of solid chrome carbide in contrast to attaching individual pieces as has been done with tungsten carbide in the past. The lightweight of chrome carbide is another factor in favor of this design concept.

FABRICATION

In general, the same methods used in fabricating tungsten carbide are used for Grade 608 chrome carbide. Components can be molded to shape for standard or quantity parts. They can also be economically machined to required shapes in the presintered condition for small-lot production. Grinding, lapping, and polishing of chrome carbide is performed with conventional silicon-carbide grinding wheels, diamond grinding wheels, and diamond lapping compounds. Polished surfaces of chrome carbide have a more brilliant luster than those of tungsten carbide.

Grade 608 chrome carbide can be attached by brazing, by mechanical means, or by thermosetting resin cements. It is necessary to flash-plate chrome-carbide parts with nickel for brazing with conventional materials.

TYPICAL APPLICATIONS

The excellent corrosion and erosion resistance of Grade 608 chrome carbide combined with good abrasion resistance, point to successful applications in broad fields in industry.

In the chemical field, its resistance to acids and sodium hydroxide indicates that nozzle and control-valve components are ideal applications.

In the pharmaceutical and food-processing fields, Grade 608 chrome carbide will also find applications in valves and nozzles because of its resistance to citric and lactic acids. Scraper blades for centrifuges and seal rings for homogenizing equipment are other excellent chrome-carbide applications.

The petroleum industry in which valve components must resist abrasive fluids and corrosive liquid containing salts can make good use of Grade 608 chrome-carbide parts.

Because chrome carbide has about the same thermal expansion rate as steel it is finding wide application in the gage manufacturing field where wear resistance of gaging surfaces and temperature effects of expansion are important considerations. The corrosion resistance of the chrome-carbide gaging surfaces is also a factor in prolonging gage surface life.

The completely nonmagnetic properties of Grade 608 chrome carbide mean that it is possible to make instrument components that are nonmagnetic and yet highly resistant to wear and corrosion.

There are many other divergent applications for Grade 608 chrome carbide such as: Shear blades for molten glass, core pins for baking ceramic parts, fishing-rod guides that resist salt-water atmospheres, textile-machinery guides, mold components for die-casting processes, punches for movie film, and a host of other applications where stainless steel is not sufficiently abrasion-resistant.

Synthetic Lumber

THE trend to "synthetic lumber" has been exemplified by a host of new types of boards made from wood scraps or shreds, it is reported in the June, 1952, issue of the *Industrial Bulletin*, of Arthur D. Little, Inc., Cambridge, Mass. Pioneering work has already been done by manufacturers of plywood and the Masonite type of hardboard, and new types of boards of pressed wood are finding ready consumer acceptance. Because the new hardboards are cheaper than lumber or plywood, they

find many uses where high structural strength is not a requirement. It is expected that they will compete with plywood made from softwoods for concrete form liners, wall panels, doors, counter fronts and tops, drawers, and similar applications, and will also find use in decorative paneling and in furniture. Softwood plywood, however, will probably continue to hold its markets where high structural strength is important, and for exterior uses. Because straight, knot-free "peeler" logs, from which continuous sheets of veneer can be peeled to make plywood, are becoming poorer and scarcer, several plywood manufacturers are planning to produce hardboard or other new boards.

Increased production of synthetic lumber is taking two main directions; one is greater manufacture of conventional hardboard. One product of this type is made by saturating a preformed porous sheet of wood fibers with a thermoplastic binder and compressing it in a hot press. Another is made of wood fibers exploded by steam, then heated and pressed into sheets. The high temperature causes the dark lignin to flow and serve as a binder for the cellulose fibers which, together with the lignin, constitute most of the original wood. This process requires large plants, using so much wood that supplies of waste at the plant are usually inadequate, and specially cut logs are needed. In the South, trees are grown as a crop for this purpose, with harvesting every 20 years. At some places in the West, supplies of sawmill wastes are adequate to support a hardboard plant. With the expiration of the basic patents on this process, several new companies, most of them established suppliers of building materials, have started production, and national capacity has doubled within recent years. At least one company is using slabwood for this type of hardboard and continued rapid growth is expected in the industry.

The other new direction is introduction of pressed-wood, boards with a synthetic-resin binding the wood fragments together. Most of these boards can be made in smaller plants than can conventional hardboard, and hence in many places can use local sawmill, logging, and woodworking wastes, which total up to 100 million tons of wood waste available annually. Although pressed-wood boards are well known in Europe, where scrap cannot be wasted, production has only recently started in the United States. One large new plant is being operated in California by a major plywood producer and has capacity for 50 million sq ft annually. In this process, developed in Switzerland, hammer-mill chips are bonded together to make a core which is covered with a thin layer of specially prepared and bonded shavings. This layer acts as a cross-banding and makes a surface attractive enough for use as an interior panel without further veneering.

Of the variety of processes proposed or in use, the ones designed for large-scale operation tend to rely for strength on the interlocking and felting of the wood fragments, as is done in papermaking, and to use a minimum of the expensive resin, perhaps two to six per cent of the weight of the board, the *Bulletin* points out. Recently, satisfactory boards using as little as one per cent resin have been made by controlling forming conditions precisely. Other processes use up to 25 per cent resin, but need only simple inexpensive forming equipment and are designed to enable a furniture or other woodworking plant to turn its small quantities of varied wood waste into panels for its own use, without any problems of procurement or marketing.

With so many processes available, a number of novel products from waste can be expected in the coming years. By one process the pressed-wood product is formed as a curved sheet or strip, for use in furniture, without the expensive forming necessary to curve ordinary wood. In another process the fibrous character of the wood is destroyed by pulverizing the waste, and its lignin is then said to be activated by a simple chemical treatment to make it serve as a bonding agent; only a little synthetic resin is needed. This product can be made either light or heavy, soft or hard, and is intended for furniture, doors, interior panels, and the like. Another furniture manufacturer uses a core made of ground-up wood waste, which has proved superior to conventional lumber in many instances. Another product, now produced here and in other countries uses Portland cement instead of resin to bond shavings into a light incombustible, insulating, and sound-absorbing material.

Pressed-wood products are usually made board by board in presses, with the board the size of the press platen. Processes are under development in England and elsewhere for making the board in continuous lengths, to be cut off as is convenient for handling and storage. One process calls for moving steel belts for pressing and radio-frequency heat for curing the resin; a paper or fabric surface is applied continuously as the sheet is formed.

These developments promise a substantial new market for resin manufacturers, the *Bulletin* states. Already the synthetic lumbers are taking some 36 million lb of resin annually, and some estimates of ultimate demand indicate a resin consumption of ten times this figure. Production of the types of resins used—phenolic and urea—totaled about 700 million lb in 1950.

German Diesel Locomotive

A DESCRIPTION of a new type of Diesel locomotive, the V-80 series of the German Bundesbahn, recently released by the German Federal Railroad System in Munich, is given in the July, 1952, issue of *Diesel Progress*.

Three different engine types and two different transmission types have been used. The units are so designed that they can be exchanged for each other. The V-12 Diesels are equipped with turbines driven by the exhaust gases which in turn drive the superchargers. They are fast-turning spacesaving Diesels of between 800 to 1000 hp output. In order to be able to utilize several locomotives for the propulsion of one train, a multiple apparatus has been developed which enables a one-man control from either one of the locomotives or from a car which contains the front operator's place. This new unit not only serves for the operation of the power plants but also watches over every function of the Diesel engines such as oil pressure, water temperature, fuel pressure, and the like, and it will shut off any engine on which something may be out of order and report to the engineer what it did and the reason.

The main frame is welded and consists of steel tubing with cross members, while the body has been produced from quadratic tube profiles and is welded with sheet-metal panels which make the unit something like one of the automotive unitized structures. The engineer has his seat in the middle of the locomotive. He can walk to the engine and to the steam-heating sections one floor below, through doors and stairways. Every unit of the vehicle can be removed from the top.

The power of the Diesel is transmitted either to a Voith triple hydraulic torque converter or to a Maybach-Mekydro transmission which consists of a torque converter and four automatically shifting speeds. Both types of transmissions are fully automatic. Additional reduction and distribution transmissions carry the power to the pinion and ring-gear axle drives over the universal joints and propeller shafts which are necessary in order to keep the unit well sprung and the wheel trucks, of two axles each, turning when the rails require it. The locomotive can be used for a top speed of about 60 mph when pulling passenger or freight trains, or 30 mph when used in shunting yards. A 110-volt d-c generator generates the

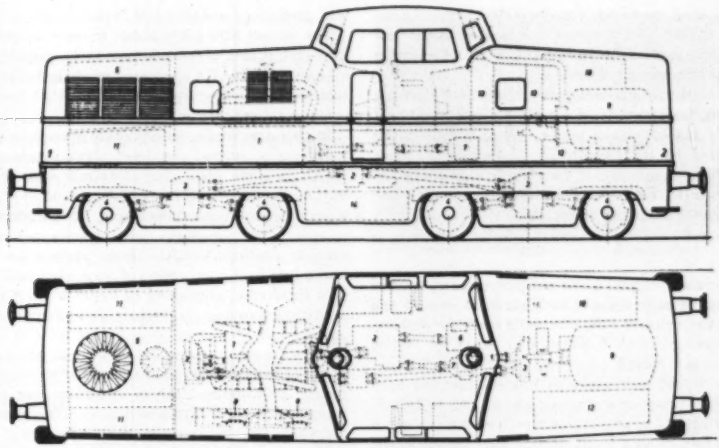


FIG. 8 NEW GERMAN LOCOMOTIVE

(1, Diesel engine; 2, automatic hydraulic transmissions; 3, reversing and distributing transmission; 4, axle drive; 5, radiators; 6 and 7, generator and starter; 8, supercharger; 9, steam boiler; 10, heating oil tank; 11, fuel tank; 12, water tank; 13, dash board.)

current for lighting and for the operation of the various armatures and instruments. A 300-amp-hr battery is also used. An oil-fired steam-generating plant takes care of the heating requirements for up to six passenger coaches.

The length of the V-80 is over-all 12.8 meters and the weight is 56 tons. The first ten units are now being delivered by Krauss-Maffei in Munich and by the MAK in Kiel. The V-80 is the first full-fledged German Diesel locomotive and starts the beginning of a new era in the field of railroading in Germany. It is interesting to note, *Diesel Progress* states, that they have not followed the design of the popular Diesel-electric combination which is in use in the United States.

Gasifier

A GASIFIER, which enables gasoline engines to start in less than 30 sec in temperatures as low as —65 F, has been developed by the Robert Reichhelm Company of Stratford, Conn. Currently being tested for use in Corps of Engineers equipment by the Army's Engineer Research and Development Laboratories, Fort Belvoir, Va., the gasifier seems to be an answer to the Army's prayer for something to combat the cold weather that has been hampering its operations in far-flung places.

The gasifier shows great promise of facilitating the starting of gasoline engines without the necessity of using an external heating source. Adequate cranking power is necessary for its successful operation, however, and arctic lubricants of low viscosity must be used in the engine crankcase.

The device supplements the carburetor for starting only. It is essentially a fuel precombustion chamber with a conventional spark plug. A quantity of the fuel supplied is burned under controlled conditions to heat and vaporize the main portion. The resultant rich, warm, gaseous priming charge is sucked into the engine upon cranking to facilitate combustion independent of initial carburetor performance. After a few minutes of operation the gasifier enables the engine to operate satisfactorily in a normal manner.

In addition to its capacity for starting engines in cold weather, the gasifier is simple to install; inexpensive, since there are no moving parts; and needs no extra accessories for operation such as an extra fuel tank. It uses the same fuel as the engine.

As operation of the gasifier requires cranking power, its value as Corps of Engineers equipment hinges on the solution of the problem of supplying such power at low temperatures. Studies on methods of cranking have long been under way.

If it performs as well in the Army as it did in civilian life, the gasifier will save the Army quite a bit of money. Available figures show that $1 million worth of gasoline and $2 million worth of man-hours a year have been wasted during the normal starting lag in cold-weather areas by registered automobiles alone in the United States.

Aluminum Coating

A NEW dipping process named "Aldip," for coating steel and other ferrous metals with aluminum, was disclosed recently by the General Motors Research Laboratories, Detroit, Mich.

Importance of the new process is said to be twofold:

1 As a corrosion or rust-resistant coating for ferrous metals, Aldip may in some applications replace zinc-coated metals.

2 When diffused by heat-treatment, Aldip becomes a heat-resistant material. This may conserve a number of strategic alloys now used in high-temperature applications, especially in defense production.

Although other methods are used for coating steel with aluminum by hot dipping, they appear impracticable commercially or too costly for large-scale production, it was explained.

The GM process is reported to be a simple, practical, inexpensive method for producing an aluminum-base alloy coating over ferrous metal of high quality. Another major advantage is the coating of an entire part or component where a high degree of formability is required.

Also, Aldip can be a continuous process for coating sheet, wire, or rod stock.

Already the Research Laboratories are producing aluminum-

coated fabricated steel manifolds for the GM Detroit Diesel Engine Division. This pilot production is housed in the new Metallurgy Building at the GM Technical Center, where other applications of Aldip are being tested.

Another pilot production is under way at the GM Harrison Radiator Division, Lockport, N. Y., with Aldip used on heat exchangers for an auxiliary tank motor, the so-called "Little Joe," manufactured by the Detroit Diesel Engine Division. The heat exchanger, consisting of two small tanks connected by a series of parallel tubes roughly similar to a miniature radiator, has complex shapes or formability.

At the Harrison Radiator Division the Aldip process is as follows:

Heat exchangers are dipped in an alkaline cleaner, washed in hot water, run through an acid pickle, rinsed in cold and hot water, and then dried in a furnace until ready for coating. These steps remove grease, oil, paint, dirt, scale, or carbon smear, if cast iron is involved.

Next, they are dipped approximately four minutes in a bath of preheating salt at temperatures ranging from 1280 to 1400 F. Then they are transferred to an aluminum bath which is covered by a layer of salt flux about a $\frac{1}{2}$ in. deep. They remain in the aluminum from 30 sec to one minute.

Thereafter, while still red hot, the heat exchangers are returned to the preheat salt bath and slowly raised. Inside and out they assume a silvery appearance as Aldip skin cools. Air-blasting removes excess aluminum.

Variation of this routine or time cycle can be utilized, depending on the part or particular component being coated with aluminum.

In the automotive field it was explained, several applications are under test. For instance, muffler inner-tube assemblies with Aldip outlast by several times plain steel center tube mufflers. Exhaust tail pipes with Aldip also withstand corrosion longer than standard tail pipes. Aldip lengthens their life against heat and condensation rust.

Longevity of steel hangers, spacers, and paint rack fixtures—all used in various auto-production operations—also has been increased as a result of aluminum dipping. It makes them more resistant both to intense heat and acids, it is pointed out.

Properties of aluminum-coated steel, it was reported, vary with steel composition and preparation, aluminum-alloy composition, time of dip, temperature of dip, and subsequent heating of the coated material. As yet, the broad field of these coatings has been only roughly surveyed.

Microscopic examination of Aldip on steel, however, reveals an outer coat of aluminum-bearing iron. A second layer, next to the steel, is an iron-aluminum alloy.

Coatings for Molybdenum

MOLYBDENUM, because of its high melting point (4750 F), offers possibilities for use in aircraft jet engines; however, it must be protected from rapid oxidation.

The National Bureau of Standards has recently conducted a study of protective coatings for molybdenum composed of chromium and frit (glass). Results indicate that such coatings greatly extend the useful life of molybdenum at high temperatures, giving better protection than either chromium or ceramic coatings alone. Various chromium-frit coatings were bonded to molybdenum specimens, then subjected to oxidation tests under tension in the range 1500 to 1800 F and to flame tests in the range 2000 to 3000 F. At temperatures of 1500 to 1800 F the coated specimens lasted for 1000 to 3000 hr. At 2800 F, with no applied load, protection for as much as 7 hr was attained, enough to be valuable for some applications.

The present NBS study is one phase of a continuing program for development of ceramic protective coatings for metals and alloys. This NACA-sponsored program has resulted in several successful NBS coating formulations that are now in regular commercial production.

In this new study, molybdenum specimens were first coated with one of several powdered chromium-bearing base coats, which in some cases also contained some frit. After firing of the base coat, in either a hydrogen or an argon atmosphere, a ceramic seal coat containing no chromium was applied to some of the specimens. Test results indicate that the most durable coatings resulted from application of a glass-free chromium base coat, followed by a glass seal coat. Addition of a third coat, consisting of lower-melting glass, resulted in a coating showing the highest durability of all those investigated.

Microscopic examination of sections shows that the chromium of the base coat has a somewhat porous structure, formed by the diffusion-welding of the chromium particles to each other and to the molybdenum base. The glass is subsequently absorbed into this structure during the firing of the seal coat. Although thermal strain and rapid creep tend to cause cracking of the coatings, adherence is excellent and the glassy layer tends to reseal the fissures, so that cracking does not result in rapid failure.

Fiberfrax Refractory Fiber

A NEW man-made ceramic fiber—a vitreous aluminum silicate—presently available in a fluffy white cottonlike mass made up of random arrangements of extremely fine fibers, was unveiled recently by the Carborundum Company at Niagara Falls, N. Y.

Trademarked "Fiberfrax," the new material is made by melting aluminum oxide, silica, and certain modifying agents in an electric furnace, then subjecting a molten stream of the material to an air blast. The stream is blown into fine fibers which are collected with special equipment. No critical materials, such as platinum, are required in the production process.

Because Fiberfrax fiber is made from inert materials at 3300 F temperatures, it is reported to have outstanding thermal properties. It is said to be able to resist temperatures up to 2300 F without loss of properties, and does not soften at temperatures approaching 3000 F. Because of the fineness of the fibers and their random arrangement, Fiberfrax fiber has excellent filtration characteristics. It is also resilient, light in weight, and not subject to corrosion by most chemicals.

The fibers are up to three inches in length, have an average

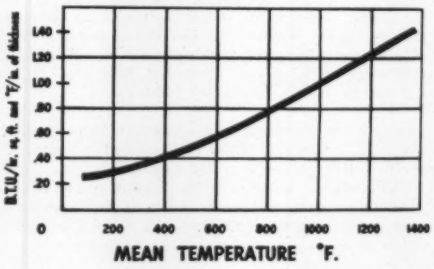


FIG. 9 THERMAL CONDUCTIVITY OF FIBERFRAX REFRACTORY FIBER AT 6 LB PER CU FT DENSITY

thickness about one twenty-fifth that of a human hair, about one fourth that of fine silk. As blown, the fiber weighs about two pounds per cubic foot. It may eventually be processed into felted blankets, firmly bonded batts, tape, or paperlike forms.

The unique properties of Fiberfrax open up a host of industrial and defense uses, according to Carborundum officials. At the present time, for example, it is finding applications as high-temperature insulation in combustion and exhaust systems of jet engines; it is under study by the Office of Naval Research for use in highly specialized papers; it can replace or be combined with critical asbestos in many electrical and thermal uses; it can be bonded into insulating panels that will not only resist fire and prevent heat loss, but will also deaden sound. As a filter, Fiberfrax fiber can improve the efficiency of gas and fume filtration.

Its inertness is said to make it possible to clean and re-use the material without loss of filtering efficiency. Studies of potential use indicate that the material may be suitable for heavy-duty brake linings, as the strength-supplying component in formed plastic laminates like radomes and body armor, in high-temperature gasketing, for vibration damping, and as a flame filter to remove ash in gas turbines. In many applications its lightweight will prove especially advantageous.

Pilot production equipment at Carborundum can produce the material at the rate of 30 tons a month. It is so new that exhaustive properties tests have not been completed and are still under way.

LINING	Thickness, in.	Max. lb/cu ft rating	Average tensile strength, psi	Average tensile strength at equilibrium, psi	Shrinkage temperature, °C	Linear shrinkage, %	Thermal conductivity, k value, Btu/(hr)(sq ft)(°F/in.)
"FIBERFRAX" FIBER	6	3	7350	4168	210	3.22	6.98
"FIBERFRAX" FIBER	12	2¾	7677	3281	175	7.44	5.50
HIGH TEMPERATURE INSULATING BRICK-CEMENTED	44.2	6½	7820	5969	231	2.71.0	1.00

FIG. 10 COMPARISON OF PROPERTIES OF FURNACE INSULATION

Fiberfrax fiber, reports reveal, is adaptable to the refractory markets served by Carborundum because its high heat resistance, lightweight, and low heat transmission make it competitive with insulating refractories for industrial furnace insulation. But its attendant properties: filtration efficiency, electrical characteristics, sound-deadening ability will, according to the company, make it desirable for use in the aviation, electrical, papermaking, and chemical fields.

Carborundum research engineers discovered the material during early work on alumina "bubbles" which are extensively used as insulation in high-temperature commercial applications. The bubbles are made by blasting molten alumina with air. During this operation it was noted that occasionally fibers were formed. By working with alumina and silica, developing modifying agents, and by extensive experimentation with temperatures and air-blast pressures, the researchers were able to carry the blowing process beyond the bubble stage, and in effect blow each bubble into a fine fiber.

Fiberfrax fiber as now produced, the company claims, can compete directly with extremely fine glass fibers in many applications. Chemical data are still being evaluated, but Carborundum research tests indicate that the material's inert source and very low alkali content make it highly resistant to acid attack. Although Carborundum's work up to now has concentrated on the high-temperature possibilities of the material, "cold" applications exist where Fiberfrax fiber can compete with asbestos fibers and provide strength, lightweight, thermal, and electrical properties.

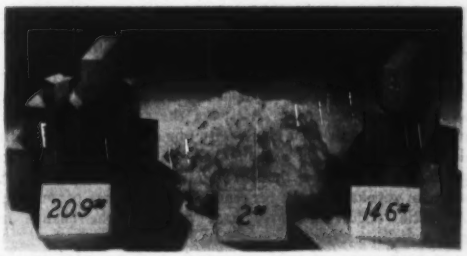


FIG. 11 FIBERFRAX FIBER AS A FURNACE INSULATOR

(Two pounds of the fluffy white material packed to a 6-lb per cu ft density fill the same volume as 14.6 lb of high-grade refractory insulating brick. But the two pounds of Fiberfrax fiber actually furnish the insulating efficiency of 20.9 lb of high-grade refractory insulating brick.)

Insulation tests show that Fiberfrax fiber, as compared to high-quality refractory insulating brick, can make impressive savings in weight and furnace efficiency. The savings are significant enough to make the material directly competitive even at the pilot-plant price of $1 a pound. Compared to high-quality cemented refractory insulating brick, tests show that 30 per cent less electric power is required to maintain furnace equilibrium at 2500 F; time required to bring the furnace up to temperature is cut in half.

At the present time, an extensive program of tests is under way by Carborundum. Samples of the material are also out on product test with a number of manufacturers. In the meantime, Carborundum is proceeding with a $500,000 plant-expansion program to make Fiberfrax fiber in greater quantities and thus reduce unit cost.

Nickel Tensile Properties

A STUDY of the effect of temperature on the tensile properties of high-purity nickel has recently been completed by the National Bureau of Standards. Tensile tests were made at temperatures ranging from —320 to 1500 F on annealed specimens of nickel of 99.85 per cent purity.

The new work is a continuation of previous NBS studies of high-purity copper and copper-nickel alloys. These two metals are both available commercially in very high purity and they and their alloys are suitable for many industrial applications. The two metals have unlimited solid solubility in each other (can be alloyed in all proportions), and these alloys have relatively high strength at elevated temperatures and are corrosion-resistant in many environments. For all of these reasons the study of the copper-nickel binary system has considerable interest and significance.

Two series of tests were made in the NBS study of nickel. The first series were made in the range from room temperature to 1500 F. Specimens were 6½ in. long, with 2-in-long reduced sections of 0.505-in. diam. Each specimen was heated and maintained at the desired test temperature, then tested in a hydraulic-type machine (15,000 lb range). The testing machine applied tension to the specimen, producing extension at a controlled rate of about 1 per cent per minute.

The movement of the head and the tension applied to the specimen were recorded by means of an automatic stress-strain recorder.

The second series of tests were made at temperatures ranging from —320 to +212 F. Specimens were essentially the same as those used in the first series, but the procedure had to be modified to permit them to be fully immersed in a liquid bath during the testing in tension. Loading was controlled to produce contraction of the smallest section of the specimen at a rate of approximately 1 per cent reduction of area per minute. A special reduction-of-area gage measured the change in minimum diameter of the specimen during testing.

In both series of tests, specimens were extended to the point of fracture. Fractured specimens were examined metallographically and tested for hardness. Various graphical comparisons of relations between the observed data were then made.

The NBS study of nickel shows that, in general, the metal's yield and tensile strength, and also the ductility at maximum load, tend to decrease with increase in temperature. The elongation at complete fracture attains a minimum at about 500 F. However, irregularities appear in the usual trends of some of the tensile properties in the temperature ranges of about 80 to 300 F and 500 to 700 F. Strain aging apparently occurs in the range 80 to 300 F, and Curie-point behavior in the range 500 to 700 F, while recovery and recrystallization predominate at temperatures of 1200 to 1500 F.

Electromagnetic Pump

A NEW a-c electromagnetic pump with no moving parts, for pumping liquid metals and other low-resistance conducting fluids at temperatures up to 1000 F, has been announced by the Special Products Section of the General Electric Company, Schenectady, N. Y.

According to G-E engineers, the revolutionary new pump can be used to move any conducting fluid that has a specific resistance equal to or less than stainless steel (approximately 90 microhm-cm). Liquid metals, such as sodium, sodium-potassium alloys, and lithium, they said, fit this classification.

The new pump operates on the principle that a current-carrying conductor in a magnetic field is acted on by a force. In this case the fluid serves as the conductor, so that when current and flux are properly applied, pumping occurs.

One of the three basic elements of the pump, a transformer unit, sets up a high current through the liquid metal and, simultaneously, a magnetic field perpendicular to that current. A cell unit, which consists of a flattened stainless-steel pipe, carries the liquid metal through the magnetic field. The third basic part, a capacitor unit, provides power-factor correction.

The amount of liquid metal which can be pumped in a given period varies with the pressure. At 20 psi the pump is able to move approximately 28 gpm of molten metal, the engineers said.

The transformer unit of the new electromagnetic pump is 19 × 13 × 12 in., the capacitor unit is 22 × 15 × 10 in., and the cell is 1-in. standard pipe of number 347 stainless steel, 10 in. long. The equipment operates on 230 volts at 30 amp.

Passenger Conveyer Belt

ENGINEERS and development researchers of The Goodyear Tire & Rubber Company's belting department in Akron, Ohio, have designed and built a "moving sidewalk" that has been subjected to more than a thousand tests, transporting hundreds of people of both sexes and all ages, even persons with leg handicaps.

Built specifically to record scientific data for final engineering plans on the high-speed conveyer-belt subway system proposed for New York City by Goodyear and Stephens-Adamson Manufacturing Company, the 68-ft passenger conveyer has passed all its tests satisfactorily after a year of continuous experimentation.

The Goodyear experimental passenger conveyer belt looks like an escalator that doesn't go upstairs.

Its over-all length, including entrance and exit ways, is 85 ft. The belt itself is 24 in. wide and is driven by a 3-hp electric motor geared for speeds from less than 1 to 5 mph.

Experiments with the passenger conveyer included tests with women wearing all types of shoes from French-heeled pumps

FIG. 12 VOLUNTEERS ACTING AS "GUINEA PIGS" DURING TESTS OF GOODYEAR'S EXPERIMENTAL PASSENGER CONVEYER PREPARE FOR A RIDE ON THE 68-FT BELT

to sandals. Goodyear workers volunteering for experiments, in some instances, were given packages to carry hampering both arms. Tests were run using small children, with and without adult guidance, either walking on the moving belt by themselves or being carried in the arms of an adult.

Conclusions reached from the experiments are: (1) Conveyer-belt transport of human cargoes is safe, reasonably fast, and economical; (2) safest operating speed for a single belt in a system on which persons are required to enter by walking is $1^1/_2$ mph; and (3) a conveyer belt meets the subway requirement of intensive efficient utilization of equipment.

Goodyear's passenger conveyer-belt test installation simulates requirements of an actual installation, even to a moving handrail synchronized with the speed of the belt. Special testing equipment was devised for the experiments.

One interesting gadget is a vibration testing machine that, when placed on the moving belt, measures severity of vibration that would be felt by a human. The machine even records vibration shock that would be experienced by a heavy woman in spike heels, the most critical vibration test.

Beneath the belt, Goodyear engineers placed several different types of idlers or gravity rollers on which the belt rides. Some are steel and some are rubber-covered; some are wide-spaced; others are almost touching.

The Goodyear-Stephens-Adamson conveyer-belt system, which is currently being studied for possible adoption by New York City's Board of Transportation, would replace the present Grand Central-Times Square shuttle. The board is headed by Col. S. H. Bingham whose ideas served as seed for the final conveyer system.

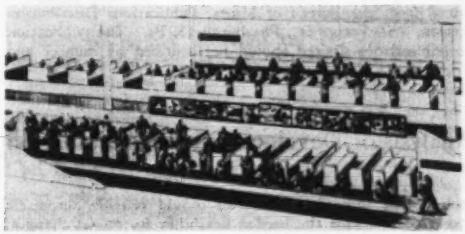


FIG. 13 ARTIST'S CONCEPTION OF LOADING AND UNLOADING PLATFORMS FOR THE GRAND CENTRAL - TIMES SQUARE SUBWAY CONVEYER BELT

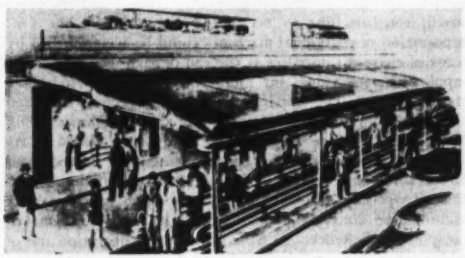


FIG. 14 DRAWING SHOWS ANOTHER GOODYEAR IDEA, MOVING SIDEWALKS, CONSISTING OF RUBBER CONVEYER BELTS AND MOVING HANDRAILS, FOR DOWNTOWN SHOPPING AREAS, SUBTERRANEAN INTERSECTION CROSSINGS, BASEBALL PARKS, RACE TRACKS, AND OTHER AREAS WHERE CONTINUOUS OPERATING TRANSPORTATION IS NEEDED TO ELIMINATE CONGESTION AND CONFUSION

The shuttle replacement plan calls for use of moving loading and unloading platforms and small closely spaced passenger cars riding on an endless track of rubber conveyer belts and rubber-tired banks of accelerator wheels. The moving platforms for loading and unloading passengers will be sufficiently apart to direct traffic flow into one-way streams, thus minimizing rush-hour confusion.

At either end of the shuttle, passengers will walk directly aboard the loading platform, a moving belt 6 ft wide. Alongside the loading belt, and moving at the same speed, $1^1/_2$ mph, will be a continuous stream of small passenger cars with seats.

Twenty-five cars, each seating 10 persons, will pass the loading platform every minute. After leaving the loading platform, the cars will be speeded up to 15 mph over banks of accelerating wheels and on the main conveyer belts.

The cars will be slowed at the other end by similar banks of wheels and move onto a belt moving at unloading platform speed. Passengers will step out of the cars to the unloading platforta, a moving belt similar to the loading platform, and walk off the far end.

Empty cars will be turned around by means of a large wheel and move alongside a loading platform for passengers going in the opposite direction.

Continuous operation feature will eliminate present waiting periods between shuttle trains and relieve rush-hour congestion.

Synthetic-Fuels Research

SEVEN years of co-operative research by the Bureau of Mines and private industry have transformed oil shale from a material that seemed to offer little hope of utilization for producing synthetic liquid fuels in 1944 to one so promising that it would now be prudent for private industry to construct a prototype commercial oil-from-shale plant, Secretary of the Interior Oscar L. Chapman reported to the Congress, recently.

The Secretary reiterated his previous recommendation that private industry, with such Government assistance as may be available, proceed to construct pioneer commercial plants to produce synthetic liquid fuels from both oil shale and coal.

"Sooner or later," the report observes, "our nation will rely in part on synthetic liquid fuels, and from the standpoint of national security it is essential that we be fully prepared when the time comes."

A few of last year's major accomplishments under the Synthetic Liquid Fuels Act of 1944, the report shows, included: putting into operation on a demonstration-plant scale a new process for producing liquid fuels from coal synthesis gas; completing cost studies for commercial plants to produce liquid fuels from both coal and oil shale; gasifying pulverized coal with oxygen under pressure on a pilot-plant scale; and starting construction of a 300-ton per day oil-shale retorting plant.

The report is issued in two volumes, one dealing with coal and the other with oil shale, and describes in detail the scientific and technologic work done last year on the production of synthetic liquid fuels from both of these raw materials. In addition, the summary reviews briefly some of the accomplishments during the past seven years in all phases of the oil-shale program, from developing extremely low-cost mining methods to producing satisfactory refined products.

During 1951, a 50-bpd gas-synthesis demonstration plant was completed at Louisiana, Mo., and successfully underwent its initial test runs. This is the nation's first gas-synthesis plant of this type. In addition, considerable progress was made toward developing an economical process for direct gasification of coal in Bureau laboratories and pilot plants at Morgantown, W. Va.

Morgantown research centered upon the gasification of pulverized coal with oxygen under pressure, upon purification of the resulting gas to produce synthesis gas, a carbon monoxide-hydrogen mixture, and upon recovery of sulphur removed during purification.

At Gorgas, Ala., in co-operation with the Alabama Power Company, experiments in underground gasification of unmined coal were continued. The second experiment was completed, and a third, utilizing the electrolinking method previously tested by the Sinclair Company in co-operation with the Missouri School of Mines was begun. This method eliminates the need for underground work by utilizing an electric current

to ignite the coal bed and open a channel between bore holes. Better-quality gas was produced during the third experiment, which continued into 1952, than during either of the others.

The coal-hydrogenation demonstration plant at Louisiana, Mo., continued to produce liquid fuels which were tested with satisfactory results in Bureau of Mines and military vehicles. Its product streams also contained a variety of needed chemicals. On the basis of experience with this plant and of laboratory and pilot-plant tests at Pittsburgh and Bruceton, Pa., process refinements were developed which improve the economics of coal hydrogenation.

The Bureau's cost estimates for coal hydrogenation, mentioned earlier, were made for hypothetical commercial-sized plants at Rock Springs, Wyo., and in western Kentucky. These sites were chosen, the Secretary emphasized, not as preferred locations for actual plants but as representative of extensive coal-bearing areas. Rock Springs was selected for study because it represents a Wyoming coal area with large reserves, and western Kentucky because it is representative of coal areas in Kentucky, Indiana, and southern Illinois.

During the year, Ebasco Services, Inc., was engaged to make an independent check of some of the more important items in the Bureau's cost estimate for coal hydrogenation. The Ebasco check included a detailed study of two important construction elements, six major operating-cost factors, the marketability of chemical co-products, company-financed housing requirements, and methods of financing initial plants. This study, the report notes, supported many of the important cost-factor estimates of the Bureau. Both the Bureau's estimates and Ebasco's findings were based on costs and economic conditions as of January 1, 1951.

The report notes that something in the way of Government incentives to private industry appears to be required at this time, making the following quotation from the Ebasco findings:

"We do not believe it would be feasible to finance the projects described in the Bureau of Mines report dated October 25, 1951, with private capital under conditions prevailing on January 1, 1951."

Turning to oil shale, the report notes that one of the year's outstanding events at Rifle, Colo., was the start of construction of a 300-ton per day Bureau-developed gas-combustion retort. The soundness of the gas-combustion technique, which requires no external heat-exchange equipment and no cooling water, previously had been established on a pilot-plant scale. Shale mining during the year was largely restricted to the needs of the oil-shale demonstration plant and little mine development was undertaken. However, some progress was made in drilling techniques.

Operations at Rifle during the year provided much of the information needed for adapting conventional thermal refining techniques to treat shale oil. The gasoline produced, the report adds, is being used regularly in plant vehicles. Its performance appears equal to that of the corresponding petroleum product, as does that of shale Diesel oil, which has been used in the plant trucks and equipment for nearly two years and also has been subjected to extensive testing in Diesel railroad locomotives.

The Bureau made detailed cost estimates for a 250,000-bpd oil-shale operation, incorporating the newest developments in mining, retorting, and refining. Two refining plants were considered, one using basic thermal cracking and the other a mild hydrogenation process developed by the Union Oil Company of California. Based on a capitalization of 50 per cent equity and 50 per cent borrowed funds, the report estimates the rate of return on equity capital after income taxes at 8.4 per cent for thermal refining and 11.2 per cent for mild hydrogenation on the basis of January, 1951, prices for the products.

At the Bureau's Petroleum and Oil-Shale Experiment Station at Laramie, Wyo., laboratory work on the development of a process for retorting oil shale at high temperatures reached the point where construction of a pilot plant was begun. The report explains that high-temperature retorting makes it possible to produce valuable chemicals such as ethylene and benzene from oil shale.

In its refining research at Laramie, the Bureau developed improved methods for treating thermally cracked shale gasoline and improving distillate stocks for use either as Diesel fuel or as catalytic-cracking stocks.

The report is in two volumes. A free copy of Report of Investigation 4865, Part I—Oil From Coal and of Report of Investigations 4866, Part II—Oil From Oil Shale, can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa. The publication or publications desired should be identified by number and title.

Analysis of Developments in Automation

(*Continued from page 811*)

each of the individual machines would provide automatic operation and also the needed flexibility for model changes. However, this would not be automation as the parts must still be loaded and unloaded, and the machine started by the operator.

Automatic loading and positioning devices for each machine could be operated by the programming control and the parts moved from machine to machine by conveyers. The synchronization of individual machines could be accomplished by means of electrical impulses at the end of each tape operation, stopping the individual machine, and closing a switch in a starting circuit. The starting circuit would become activated when all the switches in the circuit were closed—thus starting the machines on a new cycle. No set-up time would be required for a model change, except the changing of the tools and the threading of new tapes in the individual programming controls. Or perhaps the machines would be joined by a transfer machine-type conveyer which serves the dual functions of transporting the workpiece from operation to operation and of holding the workpiece during the machining operation. The automatic loading and transfer equipment discussed here has not yet been designed, but it is suggested as a development which would extend the area in which automation is possible.

On the other hand, it would seem dubious that programming controls would be used to produce large quantities of identical products, when the automotive companies have demonstrated that the job can be done effectively with relatively less-expensive electric circuits utilizing limit switches and mechanical interlocks. The flexibility inherent in programming controls is just not required in large volume production.

CONCLUSION

Programming controls are not the one answer to automation, or even to automaticity. Electric circuits utilizing limit switches and mechanical interlocks will always have a major part to play. However, where flexibility of operations is necessary, programming controls will come to play an increasingly important role, both in application to general purpose machinery and to flexible, but more specialized, machinery used in producing a line of products.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Oil and Gas Power

Lubrication Problems in Design of Heavy-Duty Engines, by W. J. Blessing, Worthington Corporation, Buffalo, N. Y. 1952 ASME Oil and Gas Power Division Conference paper No. **52—OGP-1** (mimeographed).

THIS paper reviews lubrication and related design problems with respect to reciprocating and rotating parts of heavy-duty Diesel and gas engines. It also considers the lubricant and the relative merits of lubricating systems external of the engine.

The manufacturer has no control of the factors which influence proper maintenance, once the engine has been delivered. His responsibility, therefore, lies in providing a design capable of operating efficiently within an oil "specification" range determined by him. The constant increase in ratings and speeds of commercial engines requires changes in lubricating-oil recommendations from time to time. More emphasis is given to viscosity, resistance to heat, low-carbon formation, and nonsludging characteristics.

It is concluded that the following important items should be considered:

1 The oil must be of suitable quality to prevent carbon formation and ring sticking, and of proper viscosity to give the necessary film strength at operating temperatures.

2 Oil grooves must be provided, where necessary, to insure adequate distribution of the oil film over the entire oil surface.

3 Sufficient pressure must be developed in the engine system to insure adequate lubrication to all points and not higher than necessary to prevent the possibility of excess oil being thrown about, thus inducing high oil consumption.

4 The rate of circulation must be ample not only to provide adequate lubrication, but also necessary cooling.

5 Samples of the oil must be frequently taken and carefully analyzed to detect presence of water due to accidental water leaks or high neutralization number or fuel-oil dilution or, where detergents are used, to determine when these detergents have been expended.

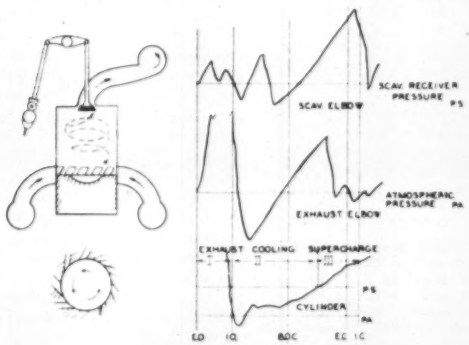
6 Adequate filtration is strongly recommended to keep the oil in good condition for a reasonable length of time.

7 Even though satisfactory filtration is provided, one must not assume that it is never necessary to change the oil.

Recent Developments in Spark-Ignition Gas Engines, by W. M. Kauffmann, Jun. ASME, Worthington Corporation, Buffalo, N. Y. 1952 ASME Oil and Gas Power Division Conference paper No. **52—OGP-2** (mimeographed).

RECENT progress toward higher efficiency of the spark-ignition gas engine has demonstrated the following:

1 Maximum output is controlled by



SCAVENGING SYSTEM TWO-CYCLE UNIFLO SPARK-IGNITION GAS ENGINE

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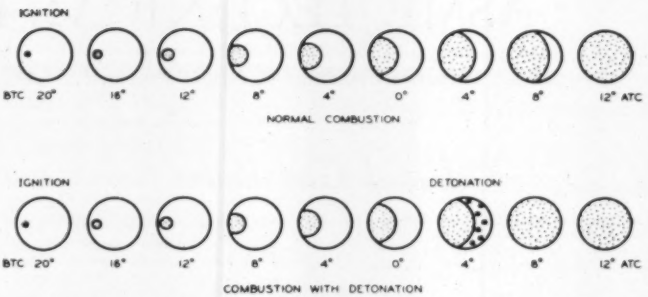
factors related to knock-limited performance, namely, air-fuel ratio, manifold air temperature, composition of the fuel, spark advance, combustion-chamber design, and jacket-water temperature.

2 Reliability of these high-compression engines depends on an ignition system having characteristics such as adequate power supply, minimum spark-plug electrode wear, minimum variation in spark timing, least wearing parts for longer life.

3 Thermal efficiencies equal to that of the most efficient dual-fuel engines may be obtained.



ADVANCE OF FLAME FRONT WITH NORMAL COMBUSTION AND DETONATION

Combustion Fundamentals of Heavy-Duty Gas Engines, by W. K. Newcomb, Mem. ASME, Ingersoll-Rand Company, Painted Post, N. Y. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-3 (mimeographed).

FOR many years the spark-ignition gasoline engine has been firmly entrenched in the automotive field. More recently the use of large spark-ignition gas engines has been greatly expanded due to the rapid growth of the natural-gas and petroleum industries. This paper reviews combustion fundamentals and shows why this progress has been possible and how it has been made.

For example, the gain due to raising the compression ratio is twofold; the specific fuel consumption is decreased and the maximum output of the engine is increased. Both of these factors contribute to a lower heat-rejection rate and put more of the heat value of the fuel into useful work.

Detonation, it is pointed out, is objectionable in all engines because of the shock effect. If severe, it will cause loss of power and damage to engine parts.

Early investigators learned that detonation could be stopped by lowering the compression. Also the shape of the combustion chamber, the location of the spark plug, and turbulence are important factors in raising the detonation level. In one engine, four different spark-plug locations were tried before the optimum was found. Modern engines are designed with as many of these features as possible.

There are other factors which affect detonation but it is not always feasible or practical to take advantage of them. For example, high load causes detonation and reducing the load stops detonation. It is important that we avoid rating an engine too high. High ambient temperature has been known to cause detonation. Lowering the air temperature will stop it, but an engine must be able to run on any air temperature encountered. Likewise, high water-cooling temperature promotes detonation, but high water temperature is desirable to minimize cylinder wear. Retarding spark timing reduces tendency to detonate but this reduces power and economy.

Detonation is often mistaken for preignition, but there is no direct relation between them; they are two different phenomena. Preignition is combustion occurring before the electric spark and it is ignition of the fuel-air charge by a hot surface such as spark-plug electrode, valve, piston top, or carbon deposit. Detonation is accompanied by a characteristic knock but preignition may be as silent as normal combustion.

Rough combustion is sometimes mistaken for detonation although they are not the same. Rough combustion is a very rapid advance of the flame front and consequently a very rapid rise in pressure. This is quite different from detonation which is autoignition of the unburned charge ahead of the flame front.

Regarding mixing-valve adjustment, the first step in adjusting the mixture is to "peak" the manifold vacuum. This is the setting for maximum power and overload capacity. If economy is desired, adjust the mixing valve leaner; the manifold vacuum will drop as the mixture is leaned, and the leaner the adjustment, the lower the manifold vacuum will be.

In order to obtain good combustion, the spark timing must be correct. Engine manufacturers specify the optimum spark setting for their engines and these recommendations should be closely followed.

A Dynamic Shear-Modulus Apparatus and Production Test Results for a Cast Crankshaft Alloy, by J. D. Swannack, Mem. ASME, and R. J. Maddock, Fairbanks, Morse & Company, Beloit, Wis. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-4 (mimeographed).

ELECTRODYNAMIC apparatus is described for producing and identifying torsional resonances in a small cast-iron sample. Shear modulus is computed from the resonant frequencies. A specimen is taken from the mold of each crankshaft. Accuracy of the procedure is discussed.

To date, well over 1000 modulus tests have been made on an acicular cast-iron alloy, and the following conclusions for that alloy are reached:

1 Shear modulus is practically a straight-line function of density.

2 Low-temperature heat-treatments that raise the tensile strength greatly from the "as-cast" condition have negligible effect on modulus. In fact, no tangible correlation between shear modulus and tensile strength has been discovered.

Electrical Ignition of High-Compression Engines, by Sidney E. Miller, Mem. ASME, American Bosch Corporation, Springfield, Mass. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-5 (mimeographed).

THE great progress made in the past few years in the development of high-compression natural-gas engines has demanded an equally rapid advance in the design of electrical ignition systems capable of reliably firing such engines.

Compression pressures of 500 to 600 psi are now commonplace engine design figures. The ignition problems which arise as a result of the greater charge density, the leanness of the mixture, and the capacitative loading of the high-tension leads caused by shielding requirements have been many and difficult of solution.

As a result of a great amount of field testing, it became increasingly evident in 1946, that the reliability of electrical ignition systems suitable for application

to large natural-gas engines was limited by the life expectancy of the contact points used to interrupt the ignition-transformer primary current. Since all systems commercially available at that time employed breaker points, it was decided that if optimum ignition service life was to be obtained, a new type of system without breakers must be developed.

The breaker in a conventional ignition system is used only to cause a rapid change in flux in the ignition-transformer core by interruption of the primary current. This rapid change of flux linking the transformer secondary induces therein the high voltage necessary to break down the spark-plug gap. A pulse of current having a sufficiently steep wave front will, if supplied to the transformer primary, simulate the transient condition obtained with a breaker system. The initial work, therefore, in the development of a breakerless ignition system centered about the design of a generator to produce these current pulses.

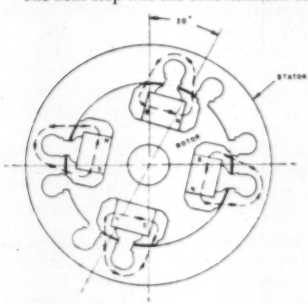
The next step was aimed at obtaining an even greater degree of dependability by making the generator self-excited. A magneto-type generator was designed and tested.

This self-excited machine gave satisfactory output on a two spark per pulse-cycle basis; however, with the alternately opposite sense of the flux pulse produced, the system was not suitable for use with a rectifier because of the resulting uneven firing intervals. Since the use of a rectifier to reduce the output to a one-spark per pulse basis and provide the most precise ignition timing was deemed necessary by some engine designers, further development was indicated.

In order to utilize fully the available magnet energy by retaining complex flux reversal, a four-magnet generator design was evolved.

The next step was the consolidation of generator and distributer into a single unit.

The gear-reduction section between generator and distributor was designed to allow, by proper ratio choice, application of the unit to either 2 or 4-stroke-cycle engines of 12 cylinders or less.



FLUX SCHEMATIC OF FOUR-MAGNET GENERATOR

The Application of Internal-Combustion Generating Units in the Rural Electrification Program, by Everett J. Raushenberger, Rural Electrification Administration, Washington, D. C. 1952 ASME Oil and Gas Power Division Conference paper No. **52—OGP-10** (mimeographed).

THE present trend is for several of the distribution co-operatives, with common boundaries, to organize a power co-operative. These power co-operatives are formed primarily to take advantage of the economies of large-volume power production. Some have arranged to secure their power from hydroelectric developments of the government. Some are erecting large generating plants for stand-by service and to firm up the hydro power supply. Others plan to produce all their own power and are building central stations having units as high as 40,000 kw. In that size class, steam turbines are used as prime movers. Where natural gas is available, central stations having capacities of 10,000 kw are constructed using internal-combustion engines as prime movers.

Initially, the REA co-operative was a relatively small system which if not accessible to a source of purchased power, was served most efficiently and economically by a small Diesel generating plant. As the co-operative grew, plants became larger and in many cases separate generating plants using Diesels were spotted along the transmission lines of a co-operative. At the end of 1951, 113 internal-combustion plants accounted for 264,081 kw or 47 per cent of the total installed capacity, 14 steam plants for 269,500 kw or 47 per cent, and 24 hydro plants for 36,141 kw or 6 per cent.

Of the total generating capacity placed in operation during 1951, 105,000 kw was steam generation and 26,701 kw was internal combustion. Percentagewise, the internal-combustion engines represent a smaller part of the total installed capacity than in past years. However, the actual installed capacity of the internal-combustion units installed annually since 1946 has remained about the same. The trend is to increase the generating capacity in the existing plants rather than construct more new plants. Most new plants being constructed use the larger-size generating units and natural gas as a fuel.

At the end of 1951 there were 395 internal-combustion engines with a total capacity of 264,081 kw operating in 113 plants financed by REA. About 25 per cent of the total number of units operating have ratings in excess of 1000 kw and represents approximately 55 per cent of the total capacity. Consistent with the trend to install larger internal-combustion plants is the trend toward larger individual engines. The largest-size engine that still permits favorable competitive bidding is of about 2700 kw capacity.

The internal-combustion engines are not alone in the REA power production picture as they were during the early years of the program. The prospects for their continued use in construction of isolated plants is certain. Their use in expansion of existing internal-combustion plants is also certain, especially if economic superiority over purchased power can be realized. Experience is proving that a combination of steam and Diesel results in lowest over-all investment and the lowest operating costs in serving rural systems.

Diesel Power Plants Versus Steam Power Plants, by Glen V. Yarger, Municipal Utilities, Waverly, Iowa. 1952 ASME Oil and Gas Power Division Conference paper No. **52—OGP-6** (mimeographed).

THE paper points out that the total cost of operating a 5000-kw Diesel plant amounts to 9.738 mills per kwhr compared with 9.517 mills per kwhr for a 5000-kw steam power plant. However, the fixed costs or nonoperating expenses must also be considered.

In the case of a steam power plant the capital investment is greater than in the Diesel plant, thereby increasing the depreciation and insurance costs of the steam plant. Therefore the total non-operating expense for the Diesel plant amounts to only 3.516 mills per kwhr compared with 6.832 mills per kwhr in the case of the steam power plant, or just about double.

Taking these costs and adding them to the regular operating expenses, it costs 13.153 mills per kwhr output per year in the case of the Diesel plant. The steam power plant costs amount to 16.349 mills per kwhr output per year.

It is also important to remember that with a Diesel power plant these operating expenses remain quite constant, whether considering a small plant or a larger one. This situation is made possible by the wide choice in sizes of Diesel-engine units which can be obtained to fit various generating loads. A steam plant, on the other hand, is not quite as flexible. While it may be true that operating costs

in the case of a steam plant will decrease slightly as the size of the plant grows, fixed costs are going to be higher.

However, there might be a factor, such as too many reciprocating parts, or too large reciprocating parts in a power plant which would have a tendency to limit the maximum size of Diesel power plants. There are, however, some very large Diesel plants used in the aluminum industry.

In the case of steam power plants, there seems to be no limit to the larger size.

Torsional Vibration Notes With Solutions for an Untuned Viscous Damper and a Flexible Coupling With Nonlinear Elasticity, by F. P. Porter, American Locomotive Company, Schenectady, N. Y. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-7 (mimeographed).

SEVERAL special relations are derived that may be used to simplify the solution of certain phases of the torsional vibration problem. A solution is described for the vibration of a system with an untuned viscous damper.

Numerical values are given for the nonlinear elasticity of the Falk-Bibby type couplings. These values are rearranged into a form suitable for calculating undamped resonance curves of an engine installation which includes one of these couplings. An approximate solution for the resulting vibration is described and illustrated by calculation.

A detailed examination of the methods used in the computations for torsional vibration reveals several important characteristics that are useful in solving certain phases of the problem. For example, the undamped, forced, vibration amplitude at the first mass of a concentrated-mass system may be obtained from the calculations of a standard Holzer table which is started at the end mass and carried through to the first mass. This amplitude, assuming that all the applied harmonic torques or impulses are equal, is the negative product of one impulse times the sum of the amplitudes at the impulses in the Holzer table divided by the residual torque of the table. A solution is given for a system with an untuned viscous damper, the solution of which becomes relatively simple when using an equivalent mass for the whole system with this mass acted on by an equivalent impulse.

The vibration of a system with a flexible coupling having nonlinear elasticity is considered. The whole system is reduced to two equivalent masses, one at each hub of the coupling where one of the masses is acted on by an equivalent impulse. An approximate solution is made by using in place of the coupling torque, its first harmonic for a harmonic variation of the amplitudes between the hubs.

Investigation on the Hydrogen Foam From the Shrunk-On Part of Web and Journal of the Diesel-Engine Crankshafts, by M. Ino, Shipbuilder's Association, Yokosuka, Japan. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-8 (mimeographed).

FOLLOWING the official trial of M.V. Yama, built at Yokohama Shipyard and Engine Works, small clusters of minute foam were found at the well-oiled boundary of the shrunk-on part of web and journal of the crankshaft of the main engine, a Yokohama-MAN Diesel. The Committee of Lloyd's Register of Shipping in London, therefore decided to restrict development to not more than 80 per cent of full power until another survey could be held after a half-year period. The M.V. Panama built at Kobe Shipyard and installed with a Mitsui-B & W Diesel Engine, and the M.V. Phillippe built at Uraga Shipyard and installed with a Kawasaki-MAN Diesel engine were also included in the restriction because of the same phenomena. The M.V. Asumasan Maru built at the Mitsui Shipyard and installed with a Mitsui-B & W Diesel engine, the M.V. Siam built at Harima Shipyard and installed with a Mitsui-B & W. Diesel engine, and all other motor vessels built in Japan, are going to suffer the same restriction fate.

The Japan Shipbuilder's Association gave the problem serious consideration and formed a special committee to investigate the gas, the cause of the formation of foam, and its effect on the reliability and the strength of the shrunk-on fit of the crank journal.

The Crankshaft Research Committee was composed of the leading engineers in the steel industry, crankshaft manufacturers, shipbuilders, and professors and they concluded that the foam gas was hydrogen emitted from the forged steel, that this is unavoidable even if the workmanship in the shrinking-on process is perfect, and that this phenomenon occasions no bad effect on the reliability of strength of the shrinkage fit.

Engine Cooling at Elevated Temperatures With Vapor Phase, by L. C. Harbert, Engineering Controls, Inc., Los Angeles, Calif. 1952 ASME Oil and Gas Power Division Conference paper No. 52—OGP-9 (mimeographed).

IN the operation of modern internal-combustion engines the cooling system has become a very important factor, both from the standpoint of temperature control to insure reliable continuous operation with low maintenance expense, and also for the reason of economy by means of efficient heat recovery.

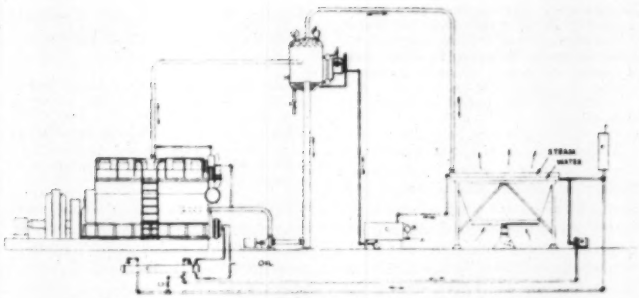
The "vapor phase" cycle considered in this paper, is primarily an engine-cooling system. However, it is frequently used as a combination cooling and waste-heat recovery system.

Two circuits are employed: (1) The primary or water circuit, and (2) the steam and condensate or secondary circuit.

The vapor phase unit, located between the engine and steam condenser, contains a built-in steam separator above the water level. A sedimentation chamber with the water outlet pipe extending up inside is built in at the bottom. Accessories include a liquid-level control valve connected to the water supply, a low-water alarm switch, pop valve, pressure-indicating gage, air vent and vacuum breaker, gage glass, and blowdown valve.

The aerial-type steam condenser in this case is mounted slightly above the vapor phase unit so as to permit gravity return of the condensate to the primary circuit. The vapor phase unit is mounted above the engine so as to provide a positive head on the engine-circulating pump and to maintain the jackets full of water at all times. The liquid-level control valve, the low-water alarm switch, and the pop valve automatically protect the engine against overheating.

The water is circulated continuously by the pump through the engine and the vapor phase unit without intentional cooling. The heat being rejected to the jackets is absorbed by the circulating water which eventually boils, causing steam to flash in the vapor phase unit. The steam passes from the vapor phase unit to the secondary circuit where it is condensed and the condensate returns by gravity to the primary circuit. All air and noncondensable gases are vented to atmosphere through the pipe connected to the condensate tank at the bottom of the condenser. The condenser should be capable of condensing all steam generated at highest ambient temperature when the engine is operating at maximum load. The result will be a completely closed cooling system requiring only such make-up as will be necessary to replace loss of water from leakage. The circulating water enters the vapor phase unit tangentially causing a swirling action inside. Any solids in the water are thrown down into the sedimentation chamber which is baffled to arrest the swirling and to trap the solids below the



VAPOR-PHASE COOLING OF JACKETS WITH LUBRICATING OIL COOLED BY WATER

water outlet from where they are blown down occasionally. Any salts of temporary hardness contained in the make-up water are precipitated by boiling inside the unit and thus prevented from entering the engine jackets. Make-up water containing sulphates or elements that do not precipitate by boiling must, of course, be treated to prevent formation of scale in the primary circuit.

Applied Mechanics

Large Deflection Theory for Orthotropic Rectangular Plates Subjected to Edge Compression, by Syed Yusuff, Brooklyn, N. Y. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-38** (in type; to be published in the *Journal of Applied Mechanics*).

A THEORY is presented of the large deflections of orthotropic (orthogonally anisotropic) rectangular plates when the plate is initially slightly curved and its boundaries are subjected to the conditions prevailing in edgewise compression tests. Results are given of computations carried out for four different combinations of load and lamination in Fiberglas panels. These theoretical results duplicate the substantial variations in the load-strain and load-deflection diagrams obtained earlier in experiments at the Polytechnic Institute of Brooklyn.

The Elastic Sphere Under Concentrated Loads, by E. Sternberg, Jun. ASME, Illinois Institute of Technology, and F. Rosenthal, Armour Research Foundation, Chicago, Ill. 1952 ASME Applied Mechanics Division conference paper No. **52—APM-37** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper contains an exact solution for the stress distribution in an elastic sphere under two equal and opposite concentrated loads, applied at the end points of a diameter. The solution is based on the Boussinesq stress-function approach to axisymmetric problems and is represented as a sum of two solutions: A singular solution in closed form, and a series solution corresponding to surface tractions which are finite and continuous throughout the surface of the sphere. It is shown that the singularity at the points of application of the loads is not identical with that arising at a concentrated load acting normal to a plane boundary. The existence of pseudo-solutions to the problem under consideration, as well as to concentrated-force problems in general, is illustrated, and the validity of the present solution is confirmed through a limit process applied to the case of tractions uniformly distributed over a portion of the boundary. The numerical results for the normal stress on the plane of symmetry perpendicular to the load axis, are compared with the corresponding stress values obtained in a recent three-dimensional photoelastic investigation of the same problem by Frocht and Guernsey.

A Simple Method of Determining Plastic Stresses and Strains in Rotating Disks With Nonuniform Metal Properties, by M. H. Lee Wu, Mem. ASME, National Advisory Committee for Aeronautics, Cleveland, Ohio. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-25** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper presents a simple method of solving plastic deformation of a rotating disk having nonuniform metal properties. A stress-strain surface, which is formed by stress-strain curves obtained from the tensile specimens cut at different radii of the disk in the tangential direction, is introduced. The distributions of plastic stresses and strains can be obtained by a simple multiplication with the use of a short table given in the paper and a stress-strain curve along the radius of the disk determined from the stress-strain surface. The rotating-speed parameter is simplified to a simple algebraic function of maximum octahedral shear strain of the disk, and a parameter determined directly from the stress-strain curve along the radius of the disk. A chart calculated from such relations is given. The relation between rotating speed and maximum strain determined from the chart is compared with the experimental data of disk test; results agree well.

Determination of Theoretical Plastic Stress-Strain Relations for Variable Combined Stress Ratios, by L. W. Hu and Joseph Marin, Mem. ASME, The Pennsylvania State College, State College, Pa. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-29** (in type; to be published in the *Journal of Applied Mechanics*).

TO distinguish between the various theories of plastic flow defining plastic stress-strain relations under combined stresses, it is necessary to conduct combined stress tests in which the ratio of the stress components does not remain constant during the test. To compare these results with the flow theory of the second stress-invariant type, graphical methods have been used to determine the combined plastic stress-strain relations based upon the simple tension plastic stress-strain relations. This paper presents an analytical procedure for the determination of these theoretical stress-strain relations. For certain stress conditions the graphical methods have the disadvantage of yielding inaccurate results—an objection not present in the proposed method. Furthermore, the proposed analytical method is less time-consuming than the graphical methods.

Experiments on the Plastic Compression of a Block Between Rough Plates, by J. F. Nye, University of Cambridge, Cambridge, England. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-10** (in type; to be published in the *Journal of Applied Mechanics*).

HILL, Lee, and Tupper have recently published a theory for the plastic compression of a block between parallel plates. This paper describes experiments designed to check the theory as closely as possible. The theoretical predictions for the average pressure on the plates are very well verified by the experiments. The details of the strain distribution within the block and the positions of the elastic-plastic boundaries are closely compared with the theory.

A Theory of Plastic Bending From a Statistical Aspect, by Hermann Craemer, Immueble Binoor, Alexandria, Egypt. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-26** (in type; to be published in the *Journal of Applied Mechanics*).

THE apparent increase of the yield stress under bending with respect to that under pure tension is explained by the lesser probability that a weak element is situated close to an edge.

The Plane-Stress Problem of Perforated Plates, by G. Horvay, Mem. ASME, General Electric Company, Schenectady, N. Y. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-19** (in type; to be published in the *Journal of Applied Mechanics*).

IN an earlier paper it was indicated that perforated plates of triangular layout, with narrow ligaments, as they occur, for instance, in heat-exchanger tube sheets, can be treated in plane-stress calculations as solid sheets of suitable elastic moduli, provided that the stress distribution does not vary appreciably from hole to hole. This paper completes that study by providing suitable curves, from which deformations and stresses can be read off in terms of the values calculated for solid sheets, for mechanical, thermal, and gravitational loads.

Thermal Stresses in Bodies Exhibiting Temperature-Dependent Elastic Properties, by H. H. Hilton, Jun. ASME, University of Illinois, Urbana, Ill. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-32** (in type; to be published in the *Journal of Applied Mechanics*).

EXPRESSIONS are derived for thermal stresses and strains due to a steady-state temperature gradient in a thick-walled cylinder and a circular thin plate, made of a material having temperature-dependent elastic properties. Two numerical examples are computed for specific temperature gradients and temperature-dependent elastic properties, which yield results showing that the maximum thermal stresses are appreciably lower and the maximum thermal strains are larger than the corresponding values obtained for temperature-independent properties. The validity of the thermal plane-stress assumptions is investigated and it is shown that such solutions, regardless of whether the material properties are temperature-dependent or constant, are only approximations. The smaller the temperature gradient the more closely are the plane-stress assumptions satisfied.

Temperature Development in a Heated Contact With Application to Sliding Contacts, by Ragner Holm, Stackpole Carbon Company, St. Marys, Pa. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-24** (in type; to be published in the *Journal of Applied Mechanics*).

THE calculation of the development of the temperature in and around a heated contact is reduced to the use of some simple formulas for certain fundamental variables and to making readings from a diagram. Applications are made to a contact that is heated by the current and to circular or oval heat sources (for example, friction-heated sliding-contact surfaces) stationary or moving on the face of a semi-infinite body. The practicability of the method is due primarily to the fact that the numerical calculations, which are made before using the standard curves, are so simple that the chance of a numerical error is very small.

A Nonlinear Problem in the Bending Vibration of a Rotating Beam, by Hsu Lo, Purdue University, West Lafayette, Ind. 1952 ASME Applied Mechanics Division Conference paper No. **52—APM-35** (in type to be published in the *Journal of Applied Mechanics*).

THE problem of bending vibration of a rotating beam is a nonlinear one when the vibration takes place in a plane not perpendicular to the plane of rotation. The nonlinear term arises from the Coriolis acceleration. From the nonlinear equation established, it is found that the existence of periodic solutions depends on the initial conditions, and the most important parameter which affects the periodic solutions is the nondimensional amplitude $\bar{A}$. The percentage error in the frequency of vibration due to neglect of the Coriolis acceleration is a function of the parameter $\bar{A}$ only. For most of the present-day applications the error is negligible.

Plastic-Rigid Analysis of Long Beams Under Transverse Impact Loading, by M. F. Conroy, Brown University, Providence, R. I. 1952 ASME Applied Mechanics Division conference paper No. **52—APM-36** (in type; to be published in the *Journal of Applied Mechanics*).

THE object of this paper is to set forth the results of an investigation of the behavior of long beams under transverse, constant-velocity impact loading, when a plastic-rigid type of analysis is adopted. It was expected that such an analysis would be satisfactory for problems involving large strains, and easier to evaluate than the corresponding elastic-plastic solution. Consideration is first given to the case of ideal plasticity. Elastic strains are neglected and the material of the beam is assumed to flow plastically at a constant yield limit. In this case expressions for the bending moment, shear force, curvature and deflection distributions along the beam are obtained analytically for any given impact velocity. The manner in which the solution for a beam having an elastic ideally plastic bending moment - curvature relationship converges to the plastic-rigid solution, as EI increases, is discussed. Consideration is next given to the case of work-hardening where the material is assumed to obey a plastic-rigid bending moment - curvature relationship consisting of a straight line with nonzero slope. Unfortunately, difficulty arises in finding a solution analytically in this case. However, by considering the solution for a beam having the corresponding elastic-plastic bending moment-curvature relationship and a large EI-value, some speculation as to the probable form of the solution may be made.

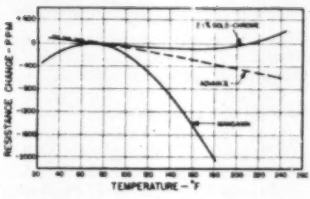
Industrial Instruments

A High-Pressure Wire Gage Using Gold-Chrome Wire, by H. E. Darling, The Foxboro Company, Foxboro, Mass., and D. H. Newhall, Jun. ASME, Harwood Engineering, Inc., Walpole, Mass. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-1** (mimeographed).

PRECISION experiments with manganin wire for the measurement of high pressures are made difficult by virtue of the temperature-resistance response of the manganin. The equilibrium time required for this material to steady out after rapid pressure changes makes manganin generally unsuited for uses in industrial-control applications. For this reason, a study was made of the pressure and temperature-response characteristics of several new materials.

An alloy of 2.1 per cent chromium in gold was found to have less sensitivity to temperature, varying from +1 to —1 part per million per deg F over the range of 40 F to 200 F, while manganin varies from +5 to —40 parts per million in this same interval. This alloy also has a strong pressure coefficient. Typical values are 0.67 to 0.72 $\times 10^{-7}$ ohms/ohm/psi for gold chrome as compared to 1.69 to 1.72 $\times 10^{-7}$ ohms/ohm/psi for the manganin tested.

Although the pressure sensitivity is



COMPARISON OF TEMPERATURE-RESISTANCE PROPERTIES OF GOLD-CHROME, MANGANIN AND ADVANCE WIRE

only 33 per cent that of manganin, the smaller temperature sensitivity of the gold-chrome results in good discrimination between temperature and pressure changes. Gold-chrome responds to pressure changes, quickly coming to equilibrium, and does not show the annoying drift so characteristic of manganin. It is generally pressure-seasoned with a single application of pressure, as compared to several cycles usually required for manganin. Its long-term stability compares favorably with manganin.

The Piston Gage as a Precise Pressure Measuring Instrument, by D. P. Johnson, Jun. ASME, National Bureau of Standards, Washington, D. C., and D. H. Newhall, Jun. ASME, Harwood Engineering, Inc., Walpole, Mass. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-2** (mimeographed).

THE errors which must be considered for accurate measurements of pressure with piston gages are discussed. A new design of piston gage is described which permits the operator to control the clearance between piston and cylinder at any operating pressure. Instrumental errors are substantially reduced, particularly those due to elastic distortion.

Three principal types of piston gage which have been made since Amagat's work are described. These are: (1) Simple cylinder and piston, (2) differential area piston, (3) re-entrant cylinder.

It is shown that in all of these designs the uncertainties which limit their accuracy at high pressures are largely due to the elastic distortions of the piston and cylinder, the latter in particular. Elaborations of these basic designs introduce uncertainties in proportion to the departure from the basic concept.

The clearance between cylinder and piston must be kept small if the piston gage is to be useful on the score of (1) knowledge of the effective area (2) high sensitivity, (3) manageable leakage of fluid past the piston. In the controlled clearance piston gage, the dimensions of the cylinder are made to change with those of the piston, so that the elastic distortion to be corrected is that of the piston alone. The controlled clearance, and consequently the leakage, is kept small. Care has been taken in the design so that elastic end effects can be neglected, thus reducing the uncertainty in the estimate of the distortions.

Techniques and Equipment for the Generation of Dynamic High Pressures, by E. J. Mickevicz, Jun. ASME, U. S. Naval Ordnance Laboratory, White Oak, Silver Spring, Md. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-6** (mimeographed).

THE Naval Ordnance Laboratory required a pressure generator for the simulation of ballistic pressure pulses in the design and evaluation of ordnance.

Hydraulic pump generation techniques were investigated but were rejected in favor of propellant powders. The objective was to develop laboratory apparatus which would subject the components being tested to a pressure-time impulse of specific predetermined characteristics. The impulse might have a peak of 40,000 psi and a duration of 10 milliseconds.

The apparatus described produces this controlled-pressure pulse, provides facilities for subjecting a captive test vehicle to this pressure pulse, includes provision for adequate instrumentation so that the various parameters of interest can be recorded, and provides for a high degree of safety and ease of handling.

Design and Application of Controlled-Volume Pumps for High Pressure in the Range of 10,000 to 30,000 Psi, by Donald H. Jones, Milton Roy Company, Philadelphia, Pa. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-3** (mimeographed).

CONTROLLED-VOLUME pumps are required for many developments in the high-pressure field and this paper is an examination of their design and application in the range of 10,000 to 30,000 psi.

Controlled-volume pumps are reciprocating-plunger, positive-displacement type pumps specifically designed to deliver accurately a metered quantity, a controlled volume, to a point of application. During the past 15 years this classification of pumps has developed from a mere adaptation of inaccurate forced-feed lubricators to the point where they are now considered precision instruments for the process industries.

These pumps, it has been said, can handle accurately quantities from a few milliliters per hour to 45 gpm, can meter difficult materials such as slurries and those with varying viscosity, and can be used in automatic pH control and concentration control systems.

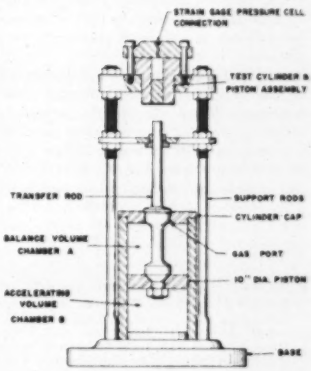
Basically, these pumps consist of a plunger reciprocating in a specifically designed displacement chamber with check valves on suction and discharge sides.

Properly designed, the displacement chamber, or liquid end, permits a controlled volume to be delivered for each plunger stroke; a quantity determined by the plunger diameter and plunger stroke length. A typical liquid end for a controlled-volume pump employs double check valves on both suction and discharge side to assure the continuance of accurate pumping should one check be temporarily held off its seat.

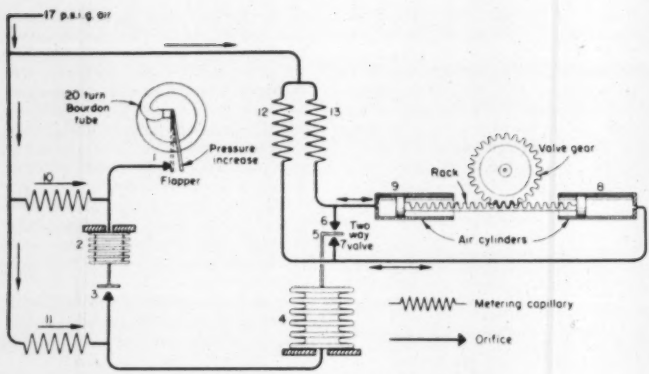
The checks are so arranged as to automatically discharge any entrained air or gas which could impair volumetric efficiency.

Static-Dynamic Load Machine for High Pressure, by E. T. Fleischhauer and E. G. Dorsey, Jr., Experiment Incorporated, Richmond, Va. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-10** (mimeographed).

THE general requirements for a static-dynamic load machine capable of testing fixed and moving seals at pressures to 50,000 psi and adaptable to delivery of impact loads of the order of 10,000 ft-lb



STATIC-DYNAMIC LOADING MACHINE



SCHEMATIC DIAGRAM OF PRESSURE CONTROLLER

are outlined. A novel valve arrangement to permit rapid load delivery is described, and the theoretical and experimental performance characteristics of the machine are discussed.

Special instrumentation available for recording experimental data is specified; in particular, the design of a strip-film camera for obtaining test velocities is examined.

Potentialities of the machine for investigating short-time-interval loading effects on seals, materials, and instruments are briefly described.

A Sensitive Pressure Controller for High-Pressure Service, by P. L. Golden and A. F. Headrick, Bureau of Mines, Bruceton, Pa. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-4** (mimeographed).

AN AUTOMATIC, sensitive, pneumatic pressure controller has been developed for regulating the flow of hydrogen to a bench-scale high-pressure hydrogenation unit. It utilizes a 20-turn helical Bourdon tube which is connected to the flapper of a nozzle-flapper combination. When the nozzle is closed, air pressure in the controller acts through a system of bellows and cylinders on a rack which drives a gear connected to the regulating valve. The controller prevents slow drifts of pressure and has operated satisfactorily at 9000 psig pressure.

Gaskets for High Pressure Vessels, by Andrew R. Freeman, American Instrument Company, Inc., Silver Spring, Md. 1952 ASME Industrial Instruments and Regulators Division-ISA Joint Conference paper No. **52—IIRD-5** (mimeographed).

GASKETS for high pressure vessels are described, with the basic properties, advantages, and limitations of the various types. The simple flat gasket is first discussed, followed by the Bridgman unsupported area closure together with some of its modifications. O-ring seals are illustrated.

Several metal seals including two basic lens-ring systems with some of their modifications, the wave ring gasket and the delta ring gasket are described, as well as some other types which offer possibilities but are not as yet in common use in this country. The theoretical approach to the design of seals is considered; in the present state of the art the choice of gaskets for high pressure is made largely on the basis of empirical application data due to the very large number of variables, the effects of many of which are not too clearly understood.

ASME Transactions for September, 1952

THE September, 1952, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Torsion of a Circular Shaft With Diametrically Opposite Flat Sides, by W. J. Carter and J. B. Oliphint. (52—S-2)

Optimum Single Propellers in Radially Varying Incompressible Inflow, by Frank Lane. (52—APM-23)

A Progressing-Wave Approach to the Theory of Blast Shock, by R. G. Newton. (52—APM-18)

On the Stresses in a Rotating Disk of Variable Thickness, by Ti-Chiang Lee. (52—APM-6)

Investigation of Annular Liquid Flow With Cocurrent Air Flow in Horizontal Tubes, by A. E. Abramson. (52—APM-11)

An Airy Integral Analysis of Beam Columns With Distributed Axial Loading Having a Fixed Line of Action, by C. M. Tyler, Jr., and J. G. Christiano. (52—APM-8)

The Concept of Complex Damping, by N. O. Myklestad. (52—APM-15)

Large Deflections of Circular Plates, by M. Stippes and A. H. Hausrath. (52—APM-12)

Bending of Elastoplastic Circular Plates With Large Deflection, by P. M. Naghdi. (52—APM-16)

Forced Lateral Vibration of Beam Carrying a Concentrated Mass, by W. H. Hoppmann, 2nd. (52—APM-20)

Large Plastic Deformations of Beams Under Transverse Impact, by E. H. Lee and P. S. Symonds. (52—APM-21)

The Free Oscillation of the Centrifugal Pendulum With Wide Angles, by F. R. E. Crossley. (52—APM-17)

Correlation of Creep Properties by a Diffusion Analogy, by Leon Green, Jr. (52—APM-22)

Bending With Axial Force of Curved Bars in Plasticity, by Aris Phillips. (52—APM-9)

Plastic Flow in a V-Notched Bar Pulled in Tension, by E. H. Lee. (52—APM-4)

Experiments on the Plastic Compression of a Block Between Rough Plates, by J. F. Nye. (52—APM-10)

A Theory of Plastic Bending From a Statistical Aspect, by Hermann Craemer. (52—APM-26)

Thermal Stresses in Bodies Exhibiting Temperature-Dependent Elastic Properties, by H. H. Hilton. (52—APM-32)

The Plane-Stress Problem of Perforated Plates, by G. Horvay. (52—APM-19)

Thin Rectangular Plates on Elastic Foundation, by H. J. Fletcher and C. J. Thorne.

Temperature Development in a Heated Contact With Application to Sliding Contacts, by Ragnar Holm. (52—APM-24)

Minimum Weight of Tapered, Round, Thin-Walled Columns, by Morris Feigen.

The Characteristics of Fuel Motion Which Affect Airplane Dynamics, by E. W. Graham and A. M. Rodriguez.

A Mathematical Analysis of the Relaxation Type of Vehicle Suspension, by Joseph Gallagher and Enrico Volterra. (52—APM-13)

Limit Design of a Full Reinforcement for a Circular Cutout in a Uniform Slab, by H. J. Weiss, W. Prager, and P. G. Hodge, Jr.

DESIGN DATA AND METHODS

The Frequency of Vibrations of Rectangular Isotropic Plates, by R. F. S. Hearmon.

BRIEF NOTES

An Exact Solution for a Rectangular Plate Problem, by J. G. Sutherland.

DISCUSSION

On Previously Published Papers by F. P. Durham, George Gerard, G. Horvay, F. A. McClintock, A. K. Oppenheim, W. A. Nash, E. Sternberg and M. A. Sadowsky, C. M. Tyler, Jr., and J. G. Christiano.

BOOK REVIEWS

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Air Freight Handling Operations

The following comments refer to papers recently published discussing the subjects of the Transit Van System of handling air freight[1] and a specific example of handling military freight at Kelly Air Force Base.[2]

COMMENT BY CHARLES FROESCH[3]

The Transit Van System[1] offers one of the most promising solutions for economical air-cargo or air-freight operation because it permits preloading in accordance with most convenient flight schedules and thus allows maximum airframe utilization.

Aircraft are expensive transportation vehicles which must be kept flying to secure maximum operating efficiency. It has been stated that daily utilization is not the one most important criterion to reduce flight costs, but it certainly helps to reduce indirect costs substantially.

Our lines have some appreciation of preloading with Constellation "Speedpaks." They can be hooked onto the bottom of Constellation fuselages in a matter of minutes and removed in the same amount of time.

With cargo lots it would seem to me that the transit van or a very large pallet represents the most efficient means of cargo handling. For maximum utility it would seem feasible to standardize the size, weight, capacity, and detail design so that airframes could be designed to carry one or several of them and be interchangeable between aircraft.

It is an easy matter to visualize such a transit van being trucked to the airport from the shipper's plant or warehouse, unloaded, and transferred to a cargo aircraft which, after flying it to its destination, could be reloaded on a trailer and trucked to the consignee with minimum handling labor, ground transportation time, and, therefore, lowest of all costs.

The dimensions 8 ft × 8 ft × 20 ft seem to be good as the size of van with which to start, and it is hoped that this system can be developed to explore its full practical possibilities.

The author's[2] description of the equipment and procedures used to handle military air freight at Kelly Air Force Base in Texas is most interesting and shows what can be done when modern freight-handling methods are applied to the movement of air cargo.

However, the mechanical handling of air cargo by means of fixed powered conveyer systems cannot attain its maximum efficiency until the general dimensions of cargo aircraft are standardized. By this is meant particularly the height of the loading floor from the ground and the loading and unloading door size.

Adequate cargo compartment door size will minimize the difficulties of spotting aircraft accurately on the loading ramp. Suitable cargo compartment size and cross-section shape should ease loading and unloading, as well as permit more efficient utilization of the available cargo space.

In other words, the cargo compartment should be rectangular in section—that is, be a virtual "flying boxcar"—and cargo doors should have dimensions such as to permit maximum expected cargo package sizes to be handled with working clearance.

The bottleneck still remains in arranging freight in the airplane and with an efficient conveyer system is quickly aggravated when the bulk of the shipment consists of heavy pieces.

Serious effort has recently been made by Lockheed Aircraft Corporation to expedite the placement of air freight within the airplane by means of a horizontal hoist combined with a pogo stick and longitudinal slots built in the floor of the aircraft. This system is fast and apparently quite capable of handling almost any size, shape, and weight of air-freight pieces which can be loaded on board.

The combination of the author's conveyer system and Lockheed's arrangement is a step forward in our studies of air-freight handling.

From a commercial viewpoint, before air freight can be offered at competitive rates, it is imperative that handling costs be substantially reduced in order to:

1 Bring such costs to a fraction of direct-flight expenses for low-flight ranges.

2 Provide the best possible flight utilization of the equipment.

3 Result in greatest number of ton-miles per hour flown per day.

COMMENT BY G. W. HEFLIN[4]

In the transportation field there has long been a need for an efficient method of handling merchandise freight, particularly LCL. This is needed not only for speeding up the deliveries from the manufacturer and wholesaler to the retailer but also to reduce the considerable losses resulting from damage to intransit shipments. The Transit Van System[1] has considerable merit in that it provides a means of reducing ground handling and permits prepacking of shipments by the shipper. Carefully planned prepacking of shipments should go a long way toward reducing damage and also toward eliminating some costly packaging. If one has ever watched the unloading of freight cars at city freight terminals and the rehandling of package freight to hand trucks, to motor trucks, and back to railroads or truck lines for reshipment, he can get a good idea of the costliness of handling less-than-carload freight shipments. The costliness of handling small shipments has not encouraged the railroads to provide the best service possible to the LCL shipper, and because truck lines can offer speedier delivery, the railroads have lost a large share of such shipments.

It would be ideal if a standardized transit van could be developed for use not only by the railroads but the truck lines and airlines as well. The specialized requirements of the air lines in particular, however, and the problems of airplane design are not conducive to development of a transit van which would serve all three modes of transportation alike. The air lines, with their problems of stowing shipments within the contour of a fuselage and with the emphasis that

[1] "The Transit Van System of Transportation," by J. R. Alison, MECHANICAL ENGINEERING, vol. 74, May, 1952, pp. 377–380.

[2] "Air Freight Handling at Kelly Air Force Base," by I. E. Campbell, MECHANICAL ENGINEERING, vol. 74, February, 1952, pp. 119–122.

[3] Vice-President, Engineering, Eastern Air Lines, New York, N. Y.

[4] Manager Aircraft Acceptance, Trans World Airlines, Inc., New York, N. Y.

must be placed on weight saving, could not find a practical and economic use for a heavy and bulky van designed to fit truck beds and flat-car railroad equipment. More and more air lines are finding that, in order to handle the full weight payload of an airplane, every bit of available space in the cargo hold and bins must be utilized. Certainly a square-type transit van would not permit full utilization of the volumetric capacity of a fuselage, the design of which is dictated not primarily by its space-carrying ability but instead on aerodynamic and structural requirements as well.

It is a recognized fact that the air-freight volume of the air industry is directly related to the rate structure. With each lowering of rates made possible by reduced direct operating and handling costs, the growth possibilities are astronomical. In order to achieve these lower rates, we first must design an airplane capable of operating at extremely low direct costs. For example, at a rate of 12 cents per ton-mile and assuming an average load of 10 tons, revenues would cover direct operating cost of only $1.20 per airplane mile. Based on a 60 per cent load factor, this suggests an airplane having a payload of 32,000 lb and, depending on its range, a gross weight of 140,000 to 170,000 lb. The writer regrets that it is not possible to design such an airplane to operate within this cost range at present. In other words, airplane cost today would not permit at reasonable load factors sufficient revenue to carry the direct cost at 12 cents per ton-mile. When indirect costs are added to this, the requirement for a more economic cargo transport becomes even more difficult to achieve. It is true that much larger airplanes will reduce the cost per available ton-mile, but before this can happen, the turboprop or turbojet transport must reach the most optimum fuel economy, and airports must be developed to handle air Goliaths.

It is easy to realize that, with this problem of achieving payload with the least possible direct cost, we cannot at the same time subtract from this payload by means of heavy and bulky cargo containers designed to a standard suitable to both surface and air transportation. It is not likely that even very large airplanes could tolerate payload losses due to heavy vans.

As another part of this problem, indirect cost and the cost of handling air-freight shipments must be reduced tremendously. We believe that a low rate would permit development of a great volume of cargo traffic, and with that our normal existing overhead would be diluted to such a point that it would be far less than the level of 100 per cent of direct cost that we now experience. In order to do this, however, we must find a way to prevent the addition of tremendously large indirect costs such as those caused by costly and delaying handling techniques.

A container of some sort designed for the air-transport vehicle would provide a means of reducing these handling costs and speeding up the trans-shipping of freight to surface forms of carriage. These units of necessity must be designed to waste very little fuselage volume and to be as light as durability practices will permit. For airline use we believe that the special air freight-handling techniques, discussed in the paper on Kelly Air Force Base operations,[3] offer more immediate gain to the airlines than do especially designed containers. The van idea could be adopted, however, to take the form of a platform or floor surrounded by a special cargo netting, thus achieving weight saving. These units could be prepacked before arrival of the airplane and by special handling equipment stowed in position in the airplane with minimum delay. These units could be handled mechanically to the air-freight depot for break-up into smaller shipments or possibly as a unit loaded on a truck for delivery to the receiver. It may be possible that even small containers designed especially for aircraft could be used successfully, but we do not see how a large unit having heavy door structure, side frames, and floor structure could be usable after the weight of the unit is considered. We agree that a unit such as the proposed transit van would have very great value to the military services and would permit rapid trans-shipment of materials and supplies from airports, to trucks, to final delivery to military areas accessible only by surface transportation. In this case, however, the need for expediency would offset the considerable weight of the van.

COMMENT BY HAROLD D. HOEKSTRA[5]

These papers[1,2] bring out in an excellent way the work that is being done to overcome some of the problems in the ground handling of air cargo. This phase represents a very important part of the total cost and time.

The paper describing the Transit Van System[1] brings out that during its life the freight car spends only 3 hours out of every 24 producing transportation. That is an understandable degree of utilization time-wise, but it is interesting to translate that utilization and the accompanying average speed of 20 mph, which gives 60 miles per day, into a comparative aircraft figure. Using a block speed of 250 mph for the latest cargo airplanes would be equivalent to having a daily utilization of such an airplane of only 15 min. Since cargo-aircraft utilization is generally in the range of 6 to 9 hr per day, it is apparent that the work capacity of the airplane is many times that of the freight car.

The packaging method which the transit van offers has excellent advantages in a number of ways, and it is only necessary that these advantages be balanced against the weight of the van itself, which of course must be deducted from the payload.

The second author[2] points out that the handling of cargo inside the airplane continues to be the factor which limits the speed with which an airplane can be loaded or unloaded. A great amount of work is being devoted to solving this phase of the problem, and some comments directed to the cargo aircraft itself follow:

Aircraft manufacturers, in collaboration with operators in the past several years, have done a tremendous amount of development work, and new cargo aircraft are just now coming into use which have greatly facilitated cargo operations through increased speed and economy. In addition, the Prototype Aircraft Advisory Committee, established by the Administrator of Civil Aeronautics Administration, has developed specifications for two sizes of cargo airplanes. One of these is intended to carry a 30,000-lb payload for a distance of 2000 statute miles at a block speed of 300 mph and to operate from a 5000-ft field-size airport. The other is intended to carry a 50,000-lb payload over a range of 2500 miles at a speed consistent with the best economy over the distance (low cost per ton-mile) and the field size of 6500 ft maximum, 5900 ft desired.

It should be noted that the specifications call for a relatively level cargo floor and that if other than truck-bed floor height (43 in. to 46 in.) is employed, the economy and ease of operation equivalent to the truck-height floor shall be substantiated.

Aircraft developed to meet these specifications will provide excellent progress in the direction of the aircraft predicted,[1] having speeds in excess of 400 knots and cargo capacities of 100,000 lb or more.

Recently, the CAB has proposed regulation changes which may provide, in the near future, increased payloads for cargo aircraft in the transport category with a

[5] Assistant Director for Prototype Aircraft Development, Office of Aviation Safety, Civil Aeronautics Administration, Washington, D. C.

resultant substantial improvement in economy.

COMMENT BY H. J. KNERR[6]

The elaborate and expensive devices required for loading and unloading presently available freight aircraft are necessary because the operator is forced to utilize aircraft not designed for the specific purpose of hauling freight through the air rather than on the ground.

The economics of freight transportation will compel the rapid growth of a dividend-paying subsidy-free air-freight industry once an air vehicle appears on the scene capable of reducing rates to figures comparable with those in effect on ground means of transportation.

Present-day aircraft are with us because they all have had military forebears. The wing-and-cylinder configuration succeeded the pioneer stick-and-wire form in order to meet the military requirement for more and more speed and fire power. It has been easier to convert this form to passenger carrying than to develop other forms that more nearly meet the real requirements of the traveling public for safety and comfort. The third generation of air transport is now suffering for the sins of its predecessors.

Tomorrow's air-freight vehicle must be one that is cheap to build, cheap to operate, and above all, cheap to handle on the ground. The form indicated is rectangular, not round. Square surfaces are easily formed. Boxlike interiors with wide-open floor spaces can be loaded efficiently. Truck-bed height of floor need never be exceeded, and the performance can be such that exacts no premium from the operator.

It appears that the transit van solution to the problem of warehousing, cartage, and loading of air freight fits perfectly into the aircraft-design picture here suggested.

COMMENT BY J. W. WHEELER[7]

The Transit Van System of transportation[1] would appear to be the most practical method for handling cargo in rectangular packages.

In his discussion of Kelly Air Force Base cargo-handling procedure,[2] the author shows several illustrations of the improved cargo-loading methods which are now in use. From his presentation it would appear that a reduction had been made in the number of man-hours, but that the number of employees required had not been reduced appreciably. If the traffic density at an air-cargo base is too low, no actual saving in man-hours results, because the men usually must be hired for a continuous 8 to 10-hr day.

CLOSURE BY J. ALISON

Comments have been made regarding the weight of vans in aircraft. The author feels that the surface has hardly been scratched in the art of preloading and prepackaging and that as more is learned there will be great opportunities for savings in packaging tare as well as decreasing ground time required for loading and unloading large cargo aircraft.

With suitably designed retaining devices inside the Transit Van it should be possible to better utilize available cube. It also should be possible with these retaining devices to decrease the package weight of the articles to be shipped, thereby increasing the net cargo load, with corresponding decreases in the cost of transportation. Work being done for the military on the use of special retaining devices for military cargoes in the van indicates that the weight of the van will be offset by savings in package weight of the materiel to be shipped.

There also are opportunities in the design of future aircraft to use vans or pallets the size of vans as sections of the aircraft floor. If this can be accomplished the aircraft floor can be preloaded and put in place within the aircraft structure with a minimum addition of parasite weight and minimum loading delays.

J. R. ALISON.[8]

[6] Major General, USAF (Retired), Vice-President, Air Lifts, Inc., Washington, D. C.

[7] Department Head for Engine Instruments, Sperry Gyroscope Company, Great Neck, Long Island, N. Y.

[8] President, Transit Van Corporation, Redwood City, Calif.

Engineering Unity

TO THE EDITOR:

I would like to add my ideas on the subject of unity to those already published and express an opinion which I feel has been suppressed for some reason or other.

In all of the discussions on the matter of unity that I have read nobody has stated the fact that we already have the budding plant of unity right now. If this plant is nurtured and fed, it can easily be the oak that will truly represent the whole society of engineers. Of course, I have reference to the National Society of Professional Engineers. This organization is not selective as are the technical organizations, but includes all branches of engineering and any qualified engineer can and should belong. It is strong since it invites individual effort at all levels—local, state and national.

As a member of ASME, ASM, and a past member of the American Rocket Society, I would like to point out how naturally these organizations fit into the picture of unity that I am trying to paint. These organizations along with many others are the technical (or specialist) groups within the engineering profession. We can look to the medical profession to see how our unity should be organized. The technical societies should assume the same role as the specialist societies of the medical profession. As mechanical engineers, metallurgists, or rocket specialists, we obtain from our technical groups that information which is peculiar to our special fields. However, we do not and should not look to these societies for professional representation. The medical society has its AMA for such representation and we have our NSPE. We would certainly do well to hope for such unity as the medical society enjoys.

There is one factor which, in my opinion, rules out any possibility of obtaining unity by a grouping of the technical societies. The membership requirements of most of the technical societies are not sufficient to preclude the membership of pseudo-engineers. ASME is fairly careful on this score, but ASM and ARS require only a payment of dues. I have no criticism of these policies, but I question the validity of using these organizations to truly represent all engineers. NSPE is the only group that requires the engineer to prove his title of engineer by registration, the same requirement used by the AMA. NSPE is the only group of mechanicals, civils, electricals, etc., working for all engineers.

My position in industry is such that membership in ASME and ASM is advantageous to my work. However, with little stretch of the imagination, I could join any number, and maybe all, of the technical societies. Would this increase my share in unity if Plan A were adopted?

Where is the line drawn on the membership of this expanded Engineers Joint Council? Is the American Society for Metals included? The ASM certainly includes many metallurgical engineers who have no desire or need to belong to any of the other technical societies. Will Plan A represent this engineer?

Therefore I say that we have only to expand what we already have to accomplish the unity which we sorely need. Our technical societies should

stress registration as the logical means of safeguarding the title of engineer and also stress membership in NSPE as the proper means of becoming a true member of the brotherhood of engineers. If this were done, the problem of unity would be automatically solved with no additional organizations of complex regrouping necessary. Let each group do what it was organized to do and we shall emerge with a unity which can easily match the solidarity of the medical profession.

ROLFE JOHNSON.[9]

Automatic Flight Control

TO THE EDITOR:

It has been brought to my attention that in the paper "Automatic Flight Control—Analysis and Synthesis of Lateral-Control Problem," which appeared in the April, 1952, issue of the Transactions of the ASME, an error (in the manuscript) is present in Equation [25], page 423. The expression for $\frac{1}{f_{1\varphi}} C'_{08}$ should read

$$\frac{1}{f_{1\varphi}} C'_{08} = a_0 + d_0 f_{2r} + b_1 f_{2\varphi} + F_s (c_0 - b_1 f_{1\varphi} - d_0 f_{1r})$$

Previously the coefficient of $f_{1\varphi}$ was positive. It should be negative.

REMUS N. BRETOI.[10]

Railway Mechanical Engineering, 1950–1951

WE ARE indebted to J. A. Bennett-Powell, traction sales manager, Davey, Paxman and Company, Ltd., of Colchester, England, for calling attention to incorrect and possibly misleading captions on Figs. 23 and 24, in the article "Progress in Railway Mechanical Engineering, 1950–1951," of the April issue of MECHANICAL ENGINEERING. The caption of Fig. 23 should read "827-hp Freight and Passenger Locomotive for British Railways." He also notes that the term "hydraulic drive" in the caption of Fig. 24 may be misleading. The locomotive shown is equipped with a fluid coupling on the output shaft of each main engine, but it has no hydraulic torque converter. The committee which prepared the report used the term hydraulic drive in a general sense.—Editor.

[9] Professional Engineer, Chemical Division, Koppers Company, Inc., Monaca, Pa. Mem. ASME.

[10] Research Engineer, Aeronautical Division, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

Books Received in Library

ABSORPTION AND EXTRACTION. By Thomas K. Sherwood and Robert L. Pigford. McGraw-Hill Book Company, Inc., New York, N. Y., 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 478 pp., diagrams, graphs, tables, $7.50. This volume outlines the underlying theory of such important diffusional processes as absorption, extration, drying, humidification, and dehumidification, and discusses the engineering problems connected with the design and operation of equipment for absorption and extraction. It includes a summary of the available performance data on various types of equipment, and has a chapter on the basic principles of solvent extraction. There is a bibliography.

ACTES DU COLLOQUE INTERNATIONAL DE MÉCANIQUE. Poitiers, 1950. Vol. 4: Études sur la Mécanique des Solides—Études sur la Mécanique Générale. France, Ministère de l'Air, Publications Scientifiques et Techniques No. 261, 1952. Paper, $7 \times 10^1/_2$ in., 338 pp., charts, diagrams, illus., tables, 1800 fr. Some 30 papers from a 1950 conference are reprinted in this publication, dealing with various aspects of the field of mechanics. The papers are classified under the following major subject headings: mechanics of solids, mainly in connection with soils and soil behavior; internal friction, mainly in metals; current metallurgical and strength of materials problems, such as fatigue; the application of modern calculating machines and methods to mechanics problems; the mathematical approach to aerodynamic, vibrational, and other physical problems.

COOLING TOWERS. By J. Jackson. Butterworths Scientific Publications, Bell Yard, Temple Bar, London, England, 1951. Bound, $6 \times 9^3/_4$ in., 104 pp., tables, graphs, illus., $3.50. This book has been designed to help the nonspecialist and student of chemical engineering to understand cooling towers of the mechanical-draft type. Basic theory and data are given for cooling-tower operation, design, and testing, and the author describes in detail a rational method of design for a particular type of tower, the grid-packed induced-draft tower.

DIE-CASTING. By Charles O. Herb, Editor of *Machinery*. The Industrial Press, New York, N. Y., second edition, 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 310 pp., diagrams, illus., $4.50. A practical review of current methods and equipment. The applications of the process, the machines used, and the casting of various metals are considered. Special attention is given to die steels and die design. The dies described have been classified in groups according to their most distinguishing characteristic. Alloy compositions and properties are tabulated and many photographs and drawings are provided.

FUELS AND COMBUSTION. By Marion L. Smith and Karl W. Stinson. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1952. Bound, $6^1/_2 \times 9^1/_4$ in., 340 pp., diagrams, tables, charts, illus., $6.50. A concise but comprehensive treatment of the characteristics and properties of solid, liquid, and gaseous fuels, the fundamentals of the combustion process, and the effective application of combustion principles in furnaces, oil and gas burners, internal-combustion engines, gas turbines, and rockets. Problems and literature references accompany each chapter. The chemical aspects of combustion are presented in such a way as to be readily understandable to students with an elementary background in the subject.

GRAPHIC METHODS FOR SOLVING PROBLEMS. By Frank A. Heacock, Princeton University, 1952. Paper, $8^1/_2 \times 11$ in., 113 pp., charts, diagrams, graphs. Available from Princeton University Store, Princeton, N. J., $1.90, postpaid. This book is intended as a reading guide to recent literature on graphic methods as applied to the solution of technical problems in various fields of engineering, science, and industry. Explanatory text precedes the bibliography in each of the eight sections: simple graphs and charts, the hydrograph, geometric diagrams, network charts, vectors and mechanics, descriptive geometry, nomographs, graphic analysis. Over 600 references are given, from 1937 to 1950, with a brief abstract or annotation in each case.

HANDBUCH DES WASSERBAUES. By Armin Schoklitsch. Volume 2. Springer-Verlag, Vienna, Austria, second edition, 1952. Bound, 8×11 in., 593 pp., illus., diagrams, charts, tables, $37. Continuing the revision of this classic work, the first edition of which was translated into English some 15 years ago, this second volume covers in detail the hydraulic structures connected with dams and outlet works, hydraulic power stations, drainage and irrigation, river and canal engineering. Over 2000 section drawings and photographs illustrate the text. Volume 1, issued in 1951, covered hydrology and hydraulics, water-supply engineering, sewerage and sewage disposal. The two volumes comprise a complete treatise on the subject, and furnish as well, by means of literature references, a guide to a wide range of specialized aspects and structures.

MECHANISM. By Joseph Stiles Beggs, University of California, Los Angeles, 1951. Paper, loose-leaf, $8^1/_2 \times 11$ in., eleven sections, various pagings, diagrams, tables. Available from author, P.O. Box 12, Pacific Palisades, Calif., $2, postpaid. Intended for students in an advanced course in kinematics, these compiled notes describe and analyze a wide variety of mechanisms from cams, couplings, belts, and so on, to the more complex combinations such as occur in computing devices. A certain amount of space is devoted to general theoretical considerations.

METAL INTERFACES. American Society for Metals, Cleveland, Ohio, 1952. Bound, $6^1/_4 \times 9^1/_4$ in., 335 pp., charts, illus., tables, graphs, $5. Twelve papers are printed here which were presented at an ASM seminar in Detroit in 1951. Topics dealt with include the following: theory of internal boundaries; grain shapes and other metallurgical applications of topology; interfacial energies; grain boundaries; boundary migration; phase transformations at interfaces; and other metal surface phenomena.

PATTERN DESIGN. By Henry E. Kiley and John H. Paustian. Second edition, 1952, International Textbook Company, Scranton, Pa. Bound, $5^1/_2 \times 8^1/_2$ in., 19 pp., diagrams, illus., tables, $4.75. Covers sample patterns, molding details, pattern materials and construction, match plates, and skeleton patterns. It includes the field of pattern design and cost estimates, plus a chapter devoted to design problems. Some 200 illustrations highlight the emphasis on efficient methods. This second edition reflects the materials and processes in current use, treated concisely from the engineer's viewpoint.

ASME NEWS

With Notes on the Engineering Profession

Building for the Future of America—Theme of 1952 ASME Annual Meeting

Hotels Statler and McAlpin, New York, N. Y., Nov. 30–Dec. 5

AVAILABLE preprints of numbered papers may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y. Please order by number as listed in the tentative program.

Tentative Program

MONDAY, DECEMBER 1

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (I)

Some Problems of Orthotropic Plane Stress, by *H. D. Conway*, Cornell University (Paper No. 52—A-4)

The Stress Distributions Induced by Concentrated Loads Acting in Isotropic and Orthotropic Half Planes, by *H. D. Conway*, Cornell University. (Paper No. 52—A-14)

Pure Bending of an Incomplete Torus, by *M. A. Sadowsky* and *Eli Sternberg*, Illinois Institute of Technology. (Paper No. 52—A-17)

The Bending of a Wedge-Shaped Plate, by *S. Woinowsky-Krieger*, Laval University, Canada. (By Title)*

9:30 a.m.

Aviation (I)—Materials Handling (I)—SAE (I)—IAS (I)—NSIA (I)

Panel—Air-Cargo Terminal Requirements

The Civil Aeronautics Administration Interest, by Philip A. Hahn, Division of Airports, C.A.A.

The Large Airport Operator's Views, by *Thomas M. Sullivan*, The Port of New York Authority

The Air-Cargo Transport Manufacturer's Views, by *Herman Olson*, Douglas Aircraft Corp.

The All-Freight Operator's Views, by *F. Edward Hembree*, Flying Tiger Line, Inc.

The Combination Passenger Air-Freight Operator's Views, by *Frank W. Jones*, American Airlines

9:30 a.m.

Hydraulic (I)

Pressure Surges at Large Pump Installations, by *John Parmakian*, U. S. Bureau of Reclamation

Cavitation Tests on Hydrofoils in Cascade, by *F. Numachi*, Tohoku University, Japan. (To be presented by *Robert T. Knapp*, California Institute of Technology)

Pressure Distribution About a Single Blade of an Axial-Flow Propeller Pump, by *D. A. Morelli*, California Institute of Technology

* Not presented orally; preprint available.

9:30 a.m.

Heat Transfer (I)

Vorticity Heat Transfer in Molten Metals, by *R. G. Kennison*, Knolls Atomic Power Laboratory

Report on a Liquid-Metal Heat-Transfer and Steam-Generation System for Nuclear Power Plants, by *T. Trocks* and *D. B. Nelson*, Knolls Atomic Power Laboratory

Design and Performance of Liquid-Metal Heat Exchangers and Steam Generators for Nuclear Power Plants, by *R. D. Brooks* and *A. L. Rosenblatt*, Knolls Atomic Power Laboratory

9:30 a.m.

Fuels (I)—Power (I)

Wood Burning, by *W. L. Wagner*, Detroit Stoker Co.

Turbulence Suspension Burning of Wet Wood and Other Fuels, by *Otto de Lorenzi*, Combustion Engineering-Superheater, Inc.

Wood Burning in Central Stations, by *Ray B. Boals*, Eugene Water & Electric Board, *Dale Bumstead* and *C. D. Judson*, Bumstead-Woolford

9:30 a.m.

Process Industries (I)

Cleaning of Fluids by the Use of Ceramic Filter Media, by *George B. Jordan, Jr.*, Selas Corporation of America

Felt as a Material in Industry, by *Leon D. Gruberg*

9:30 a.m.

Gas-Turbine Power (I)

Effect of Rotary Regenerator Performance on Gas-Turbine-Plant Performance by *D. B. Harper* and *W. M. Rohsenow*, Massachusetts Institute of Technology

Rotary Regenerative Air Preheater for Gas Turbines, by *A. T. Bowden* and *W. Hrynisiak*, C. A. Parsons and Co., Ltd.

9:30 a.m.

Machine Design (I)—Production Engineering (I)

Appearance Comes in Three Shades, by *Michael W. Papp*, The Warner & Swasey Co.

UNITED NATIONS, EMPIRE STATE, AND CHRYSLER BUILDINGS REACH HIGH TO CREATE THIS IMPRESSIVE SKYLINE AS SEEN FROM THE EAST RIVER

Oversize Problems in Producing a Large Drag-Line Excavator, by *P. H. Woods*, Bucyrus-Erie Co.

12:15 p.m.

President's Luncheon

Speaker: The President, *R. J. S. Pigott*, Fellow ASME
Subject: **The ASME and the Engineer**

2:30 p.m.

Applied Mechanics (II)

Frequencies of Longitudinal Vibration for a Slender Rod of Variable Section, by *James L. Lubkin* and *Y. L. Luke*, Midwest Research Institute (Paper No. 52—A-27)

Forced Lateral Vibration of Beams on Damped, Flexible End Supports, by *Donald F. Miller*, Westinghouse Research Laboratories. (Paper No. 52—A-23)

Stresses Due to Tangential and Normal Loads on an Elastic Solid With Application to Some Contact Stress Problems, by *James O. Smith* and *Chang Keng Liu*, University of Illinois. (Paper No. 52—A-13)

2:30 p.m.

Aviation (II)—Materials Handling (II)—SAE (II)—IAS (II)—NSIA (II)

Symposium on International Air-Cargo Trends

Air-Freight Development in Australia, by *Ian H. Grabowsky*, Australian National Airways

Air-Freight Development In Europe, by *D. Sj De Boer*, K. L. M. Royal Dutch Airlines

Transatlantic Air-Freight Development in Relation to Air Logistics, by *Ray Norden*, Seaboard & Western Airlines Inc.

2:30 p.m.

Hydraulic (II)

Electromagnetic Pumps for Liquid Metals, by *C. F. Cage, Jr.*, Knolls Atomic Power Laboratory

Mechanical Liquid Pumps for High Temperature, by *P. M. Clark*, Knolls Atomic Power Laboratory

Development of Special Pumps and Their Power-Supply Valves, Bearings, and Instrumentation for Liquid Metals, by *Edward F. Brill*, Allis-Chalmers Manufacturing Co.

2:30 p.m.

Heat Transfer (II)

2:30 p.m.

Process Industries (II)—ASRE

Noncombustion Gas Turbines, by *A. M. G. Moody*, The Trane Co., and *Karl F. Kayan*, Columbia University

Application of Electrical Analogy to Thermal Conduction Studies, by *Peter E. Davey*, General Electric Co.

NOTE: The above session will be held at the Hotel Commodore in conjunction with the ASRE Meeting.

2:30 p.m.

Gas Turbine Power (II)—Fuels (II)—Power (II)

Residual Fuel-Oil Ash Corrosion, by *B. O. Buckland, C. M. Gardiner*, and *D. G. Sanders*, General Electric Co.

The Use of Residual Fuel Oils in Gas Turbines, by *Philip Draper*, Shell Petroleum Co., Ltd.

2:30 p.m.

Machine Design (II)—Production Engineering (II)

Design of Shrink Fits, by *Paul R. Paslay*, The Rice Institute, and *Robert Plunkett*, General Electric Co.

Investigation of Cemented Tungsten Carbide as a Bearing Material in the Medium-Speed Range Using Different Lubricating Oils, by *J. S. Rosacka*, University of Illinois, *H. A. Erickson*, D. A. Stuart Oil Co., *H. W. Highriter*, Vascoloy-Ramet Corp., and *A. F. Gabriel*, Acme Industrial Co.

8:00 p.m.

Applied Mechanics (III)

Influence Coefficients of Tapered Cantilever Beams Computed on SEAC, by *Samuel Levy*, National Bureau of Standards. (Paper No. 52—A-25)

Nonlinear Distribution of Bending Stresses Due to Distortion of the Cross Section, by *H. H. Bleich*, Columbia University. (Paper No. 52—A-7)

Deflections of Circular Beams Resting on Elastic Foundation Obtained by Methods of Harmonic Analysis, by *E. G. Volterra*, Rensselaer Polytechnic Institute. (Paper No. 52—A-16)

8:00 p.m.

Aviation (III)—Materials Handling (III)—SAE (III)—IAS (III)—NSIA (III)

Symposium on Air Transportability

Air Transportability in the Fleet Logistics Air Wing, by *Joseph. I. Taylor*, Fleet Logistics Air Wing, Atlantic Continental

Air Transportability With Troop Carrier, by *Robert W. Douglass, Jr.*, Donaldson Air Force Base.

Air Transportability With Mats, by *Joseph Smith*, Andrews Air Force Base

Air-Transportability Capabilities of the Commercial-Freight Carrier, by *Thomas L. Grace*, Slick Airways, Inc.

8:00 p.m.

Junior (I)—Management (I)

Professional Development and the Young Engineer, by *D. Johncke*, Ford Motor Co.

Computing Machines and the Future of the Engineer, by *Walter Pitts*, Massachusetts Institute of Technology

Operation Research, by *John B. Lathrop*, Arthur D. Little Inc.

8:00 p.m.

Metals Engineering (I)

Asarco Continuous Cast Bearing Bronzes, by *J. S. Smart, Jr.*, American Smelting and Refining Co., and *Paul J. Kraus*, American Smelting & Refining Co.

Effect of Gating Design on Casting Quality, by *S. C. Massari*, American Foundrymen's Society. (35-minute motion picture in color together with introductory remarks.)

8:00 p.m.

Fuels (III)—Power (III)—Machine Design (III)—Low-Temperature Flue Gas

Air-Preheater Design as Affected by Fuel Characteristics, by *W. E. Hammond*, and *Hilmer Karlsson*, The Air Preheater Corp.

Tubular Air-Heater Problems, by *George Parmakian* and *E. F. Rothemich*, Riley Stocker Corp.

TUESDAY, DECEMBER 2

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (IV)

On a General Method of Solving Second Ordinary Differential Equations by Phase-Plane Displacements, by *Lydik S. Jacobsen*, Stanford University. (Paper No. 52—A-1)

On an Iterative Method for Nonlinear Vibrations, by *Robert E. Roberson, Jr.*, North American Aviation, Inc. (Paper No. 52—A-20)

On the Application of Impedance Method to Continuous Systems, by *Paul F. Chenea*, Purdue University. (Paper No. 52—A-28)

9:30 a.m.

Aviation (IV)—Machine Design (IV) Metals Engineering (II)—SAE (IV) AIME (I)—IAS (IV)

Requirements for Large (Light Metal) Forgings and Extrusions in the Aircraft Industry, by *George W. Papen*, Lockheed Aircraft Corp.

The Design and Construction of Large Forging and Extrusion Presses for Light Metals, by *Morris Stone*, United Engineering and Foundry Co.

Metallurgy and Production and Suitable Light-Metal Ingots for Large Forgings and Extrusions, by *Thomas L. Fritzlen*, Reynolds Metals Co.

9:30 a.m.

Hydraulic (III)

Modern Trends in Hydraulic Turbine Design in Europe, by *George A. Bovet*, Charmilles Engineering Works, Ltd.

The Design and Calibration of a New Cavitation Laboratory for Hydraulic Turbines, by *Hans Ulmann* and *R. S. Sproule*, Dominion Engineering Works, Ltd.

9:30 a.m.

Heat Transfer (III)

Symposium on Materials Problems in Heat Exchanger Design

An Evaluation of the Properties of Weld Metal for Fabricating Heat Exchangers and Vessels for Low-Temperature Service, by *Robert W. Bennett*, American Locomotive Co.

Heat-Exchanger Forgings for Low-Temperature Service, by *Henry Holtz* and *Frank S. G. Williams*, Taylor Forge & Pipe Works

Test on Fabricated Spherically Dished Floating Cover for Heat Exchanger, by *Gunnar Sunde* and *Olaf A. Sundholm*, M. W. Kellogg Co.

Protection of Heat-Exchanger Channels and Covers From Corrosion by Salt Water, by *Wilfred J. Dunsiger* and *Olaf A. Sundholm*, M. W. Kellogg Co.

9:30 a.m.

Management (II)—IIRD (I)—Materials Handling (IV)—Safety (I)—Production Engineering (III)—Junior (II)

Progress in Automatic Production, by *H. L. Waddell*, editor, *Factory Management and Maintenance*

The Formal Concepts of Automatic Production, by *Norbert Wiener*, Massachusetts Institute of Technology

9:30 a.m.

Fuels (IV)—Power (IV)

Combustion of Pulverized Coal in Water-Cooled Radiant Tubes, by *R. A. Sherman*, Battelle Memorial Institute, *T. R. Sawyer*, Steam Locomotive Research Institute Inc., and *G. E. Keinath*, Battelle Memorial Institute

The Development of a Vaporizing Oil Burner, by *J. A. Johnson* and *E. H. Eustis*, Thermal Research & Engineering Corp.

Pulverized-Coal Gasification—Ruhrgas Processes, by *Kurt Traenckner*, Essen, Germany

9:30 a.m.

Gas Turbine Power (III)

Some Considerations in the Installation of the Gas Turbine in a Closed Compartment, by *L. W. Shallenberg*, J. O. White Mechanical Laboratory, and *K. E. Schlachter*, U. S. Naval Engineering Experiment Station

Closed-Cycle Air-Turbine Plant, by *S. T. Robinson*, Sanderson & Porter

12:15 p.m.

Heat Transfer Luncheon

Presiding: *A. C. Mueller*, E. I. du Pont de Nemours & Co., Wilmington, Del.

Speaker: *W. E. Lobo*, director of Chemical-Engineering Division, M. W. Kellogg Co., New York, N. Y.

Subject: **Problems in Heat-Transfer Application**

1:30 p.m.

Fuels (V)—Power (V)—Air Pollution Controls

Recent Developments and Progress in Air-Pollution Abatement, by *A. D. Brandt*, Bethlehem Steel Co.

Health Aspects, by *R. A. Kehoe*, University of Cincinnati

Air Pollution Indicated by Symptoms on Vegetation, by *P. W. Zimmerman*, Boyce Thompson Institute

Some Legal Aspects of Air Pollution Abatement, by *F. L. Seamans* and *Smith Buchanan*, Ingersoll, Rodewald & Eckert

Stack Diffusion, by *E. W. Hewson*, Massachusetts Institute of Technology

Engineering and Management, by *G. F. Jenkins*, Carbide & Chemical Corp.

Sampling and Measurement, by *L. Silverman*, Harvard School of Public Health

Industrial Experiences in Fly-Ash Collections, by *B. S. Norling*, E. I. du Pont de Nemours & Co., Inc.

2:30 p.m.

Applied Mechanics (V)

The End Problem of Rectangular Plates, by *Gabriel Horvay*, General Electric Co. (Paper No. 52—A-2)

An Invariant Membrane Stress Function for Shells, by *H. L. Langhaar*, University of Illinois (Paper No. 52—A-18)

On the Plastic Strains in Slabs With Cutouts, by *P. G. Hodge, Jr.*, University of California (Paper No. 52—A-22)

Responses of an Elastic Cylindrical Shell to a Transverse, Step Shock Wave. (By Title)* by *Raymond D. Mindlin* and *H. H. Bleich*, Columbia University (Paper No. 52—A-19)

2:30 p.m.

Aviation (V)—Machine Design (V)—Metals Engineering (III)—Production Engineering (IV)—AIME (II)—IAS (V)—SAE (V)

The Large Forging Press Operation and Its Production Problems, by *George W. Motherwell*, Wayman Gordon Company

The Large Extrusion Press and Its Production Problems, by *T. F. McCormick*, Aluminum Company of America

2:30 p.m.

Heat Transfer (IV)

Panel Discussion on Heat Exchangers

Chemical-Plant Heat Exchangers, by *W. R. Meyers*, E. I. du Pont de Nemours & Co., Inc.

Petroleum-Refinery Heat Exchangers, by *M. S. Northrup*, Standard Oil Development Co.

Feed-Water Heaters, by *A. I. Ponamareff*, Westinghouse Manufacturing Co.

Welding and Brazing Tubes to Tubes Sheets, by *J. R. Hunter*, Westinghouse Electric Corp.

Code Compliances Associated With Problems in Heat-Exchanger Design, by *T. H. Miley*, Foster Wheeler Corp.

2:30 p.m.

IIRD (II)—Management (III)—Materials Handling (V)—Safety (II)—Junior (III)

Formalized Theory of Material Transfer Between Steps in an Automatic Process, by *Donald Campbell*, Massachusetts Institute of Technology

Computer and Simulation Techniques in Process Control, by *John F. Bishop, Jr.* Beckman Instruments Inc.

Approaching the Control Problem for the Automatic Chemical or Petroleum Plant, by *M. V. Long* and *E. G. Holzmann*, Shell Development Co.

2:30 p.m.

Oil & Gas Power (I)—Railroad (I)

Crankcase Explosions, by Experimental Dept., Fairbanks Morse Co.

Combustion of a Low-Volatility Fuel in a Turbo-Jet Combustion Chamber—Effects of Fuel Vaporization, by *Phil Myers*, University of Wisconsin

2:30 p.m.

Gas Turbine Power (IV)

Temperature and Gas-Analysis Surveys in the Combustion Zone of Gas-Fired Gas-Turbine Combustors, by *R. L. Riehe*, Westinghouse Research Laboratory

Fuel-Spray Examination Methods, by *F. C. Engel*, Westinghouse Research Laboratory

Industrial-Type Oil- and Gas-Fired Combustion Chambers, by *Samuel Letvin*, Thermo Products Inc.

6:30 p.m.

Hydraulic Old Timers Dinner

Presiding: *Andrew Liston*, Manager Hydraulic Turbine Dept., Baldwin-Lima-Hamilton Corp. Philadelphia, Pa.

* Not presented orally. Preprints available at preprint desk.

7:30 p.m.

Applied Mechanics Silver Anniversary Dinner

7:00 p.m.

Aviation Dinner

Presiding: *J. Carlton Ward, Jr.* Special Consultant

Speaker: The Honorable *Roswell L. Gilpatric*, Under Secretary of the Air Force.

Subject: **The History of the Inception of the Large Forging and Extrusion Program for the Aircraft Industry and Its Vital Importance to the National Defense Program for the United States**

8:00 p.m.

Management (IV)—IIRD (III)—Materials Handling (VI)—Safety (III)—Production Engineering (V)—Junior (IV)

Panel

Economic, Social, and Technical Aspects of the Automatic Factory

Social Considerations in Planning the Automatic Factory, by *Norbert Weiner* Massachusetts Institute of Technology

Panel Members

John F. Bishop	Beckman Instruments, Inc.
Donald P. Campbell	Massachusetts Institute of Technology
Marion V. Long	Shell Development Co.
T. A. Marshall, Jr.	Engineering Manpower Commission
C. E. Mason	Bristol Co.
G. M. Muschamp	Minneapolis-Honeywell Regulator Co.
H. L. Waddell	*Factory Management and Maintenance*
Alex Rathe	New York University
A. F. Sperry	Panellit, Inc.

8:00 p.m.

Oil & Gas Power (II)

Panel

(General Technical Committee)

8:00 p.m.

Fuels (VI)

Industrial Application of Ignition Arches for Single-Retort Stokers, by *T. S. Spicer*, Pennsylvania State College.

Present-Day Thoughts on Application of Single-Retort Underfeed Stokers, by *D. J. Mossbart*, Westinghouse Electric Corp.

Single-Retort Underfeed Stokers, by *E. C. Webb* and *J. E. Aitchison*, Iron Fireman Manufacturing Company

8:00 p.m.

Power (VI)

Quick Starting of Large High-Pressure, High-Temperature Boilers, by *J. C. Falkner*, Consolidated Edison Co. of New York

Controlled Starting of Steam Turbines, by *R. L. Reynolds*, Westinghouse Electric Corp.

Discussion of Quick Starting of Boilers, by *W. H. Rowand*, The Babcock & Wilcox Co.

Discussion on Quick Starting of Steam Turbines, by *Carl Schablach*, General Electric Co.

Discussion on Quick Starting of Steam Generators, by *B. J. Cross*, Combustion Engineering-Superheater Inc.

Discussion on Quick Starting of Boilers, by *A. R. Weismantle*, Foster Wheeler Corp.

Discussion on Quick Starting of Steam Turbines, by *C. D. Wilson*, Allis-Chalmers Manufacturing Company

8:00 p.m.

Machine Design (VI)

Design of Servo Gear Trains to Minimize Reflected Inertia, by *Paul Brock* (to be presented by Frank R. Bradley, Hillyer Instrument Co., Inc.)

The Motion of a Link Chain Over a Roller, by *A. E. Richard de Jonge*, New York, N. Y.

WEDNESDAY, DECEMBER 3

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (VI)

The Necking and the Rupture of Rods Subjected to Constant Tensile Loads, by *Nicholas J. Hoff*, Polytechnic Institute of Brooklyn (Paper No. 52—A-11)

The Origin of Damping in High-Strength Ferromagnetic Alloys, by *A. W. Cochardt*, Westinghouse Research Laboratories (Paper No. 52—A-21)

Effect of Damping Constants and Stress Distribu-

BROOKLYN BRIDGE ACROSS EAST RIVER FROM THE BROOKLYN SIDE

tion on the Resonance Response of Members, by *B. J. Lazan*, University of Minnesota (Paper No. 52—A-8)

9:30 a.m.

Hydraulic (IV)

Shaft Seals as Applied to Centrifugal and Axial-Flow Compressors, Panel Discussion covering design, selection, and operation by representatives of manufacturers and users of compressors

9:30 a.m.

Heat Transfer (V)—IIRD(IV)

Limits of Accuracy of Electrical-Analog Circuits Used in the Solution of Transient Heat-Conduction Problems, by *E. O. P. Klein, Y. S. Touloukian*, and *J. R. Eaton*, Purdue University

Heat-Transfer Measurements by the Method of Cyclic Temperature Variations, by *R. E. Grimble* and *S. L. Fawcett*, Battelle Memorial Institute

A Thermocouple for Measuring Transient Temperatures, by *D. Bendersky*, Midwest Research Institute.

9:30 a.m.

Management (V)—Junior (V)

Panel

1952 ASME 10-Year Progress in Management Report

Harold F. Smiddy	General Electric Co.
Phil Carroll	Maplewood, N. J.
Erwin H. Schell	Massachusetts Institute of Technology
Robert T. Livingston	Columbia University
Harold V. Coes	National Management Council

9:30 a.m.

Metals Engineering (IV)—Machine Design (VII)—Aviation (VI)

Design and Analysis Features of the World's Largest Forging Press, by *Fred T. Morrison*, Lowey Construction Co., and *Roland D. Sturm*, Alabama Polytechnic Institute

The Effect of Stress Amplitude on Statistical Variability in Fatigue Life of 75 S-T6 Aluminum Alloy, by *G. M. Sinclair* and *Thomas J. Dolan*, University of Illinois

9:30 a.m.

Power (VII)

Latest Practice in Europe for Planning and Operating High-Pressure Plants Equipped With Monotube Boilers, by *J. Gastpar*, Sulzer Brothers, Ltd.

Design Formulas for High-Temperature, High-Pressure Piping, by *F. S. G. Williams*, Taylor Forge & Pipe Works

9:30 a.m.

Gas Turbine Power (V)—Oil & Gas Power (III)—Fluid Meters (I)

Energy Flow and Conversion, by *N. P. Bailey*, Rensselaer Polytechnic Institute

9:30 a.m.

Safety (IV)

Control of Static Electricity, by *Robin Beach*, Robin Beach Engineer Assoc.

Is Your New Product Safe? by *J. V. Grimaldi*, Association of Casualty and Surety Companies

Material Handling, by *Jervis C. Webb*, Jervis B. Webb Co.

9:30 a.m.

Materials Handling (VII)—Railroad (II)

Development of Wage-Incentive Standards for a Warehousing and Shipping Operation, by *Paul J. MacCutcheon*, The Nestle Co.

The Techniques for the Development of Time Standards for Materials Handling and Indirect Labor Situation, by *W. J. Richardson*, Lehigh University

Standard Performance Time Studies for Fork Truck Operation (a current research project). To be announced.

9:30 a.m.

Cutting Fluids (I)—Metal Cutting (I)—Production Engineering (VI)

Grinding and Lapping Stresses in Manganese Oil Hardening Tool Steel, by *H. R. Letner* and *H. J. Snyder*, University of Pittsburgh

Metal-Cutting Behavior of Titanium, by *L. V. Colwell*, University of Michigan, and *W. C. Truchsmiller*

Surface Temperatures in Steel Workpiece, by *A. O. Schmidt*, Kearney & Trecker Corp.

12:15 p.m.

Roy V. Wright Lecture

Speaker: *Alfred H. Williams*, President, Federal Reserve Bank of Philadelphia

Subject: **Business Leadership in a Democracy**

12:15 p.m.

Fuels Division Luncheon

Presiding: *W. E. Reaser*, associate professor, mechanical-engineering division, Princeton University

Speaker: *Frederic O. Hess*, president, Selas Corporation of America, Philadelphia, Pa.

Subject: **Fuels in a Technical Economy**

IIRD Luncheon

Presiding: *W. G. Brombacher*

Speaker: *Gerard Piel*, publisher, *Scientific American*

Subject: **Control and Communication**

2:30 p.m.

Applied Mechanics (VII)—SESA

Elastic Waves Created During Tensile Fracture, by *Julius Miklowitz*, U. S. Naval Ordnance Test Station. (Paper No. 52—A-10)

Natural Frequencies of Twisted Cantilever Beams, by *D. D. Rosard*, Westinghouse Electric Corp. (Paper No. 52—A-15)

An Experimental Study of the Propagation of Transient Longitudinal Deformations in Elasto-Plastic Media, by *D. A. Stuart* and *E. J. Sternglass*, Cornell University

2:30 p.m.

Hydraulic (V)—Gas Turbine Power (VI)

Three-Dimensional Flow Theory of Axial-Flow Compressors, by *George F. Wislicenus*, Johns Hopkins University

Some NACA Research on Centrifugal Compressors, by *A. Johnsen* and *Ambrose Ginsberg*, Lewis Flight Propulsion Laboratory

2:30 p.m.

Heat Transfer (VI)

Mach-Zehnder Interferometer Applications in the Study of Convection and Conduction Heat-Transfer Systems, by *C. D. Coulbert*, University of California. (To be presented by *Myron Tribus*, Engineering Research Institute.) (Paper No. 52—A-9)

Local Heat-Transfer Coefficients on the Surface of an Elliptical Cylinder, Axis Ratio 1:3, in a High-Speed Air Stream, by *R. J. Drabe, Jr., R. A. Seban, D. S. Doughty*, and *S. Levy*, University of California

2:30 p.m.

Management (VI)—Junior (VI)

A Theory of Decision-Making in Management, by *Robert T. Livingston* and *David B. Hertz*, Columbia University

The Modern Theory of Communication, by *Brockway McMillan*, Bell Telephone Laboratories

2:30 p.m.

IIRD (V)—Fluid Meters (II)

True Mass-Rate Flowmeter, by *Y. T. Li*, Massachusetts Institute of Technology

Optimum Three-Mode Controller Setting for Automatic Start-Up, by *D. W. Pessen*, Minneapolis-Honeywell Regulator Co.

Analogy Between Hydraulic and Electric Drives in Servomechanisms, by *L. Gould* and *Yaohan Chu*, Massachusetts Institute of Technology

2:30 p.m.

Oil & Gas Power (IV)—Railroad (III) Lubrication (I)—ASTM

Diesel Maintenance-Control by Spectrographic Means, by *Harold R. Sennstrom*, American Locomotive Co.

Diesel Lubricating-Oil Performance as Related to the Electron Microscope, by *Ray McBrian*, Denver and Rio Grande Western Railroad

2:30 p.m.

Metals Engineering (V)

The Importance of Carbon in Ferrous Metals for Engineers, by *H. K. Ihrig* and *John T. Jarman*, Allis-Chalmers Manufacturing Co.

On the Validity of Assumptions Made in the Theories of Plastic Flow of Metals, by *J. Marin* and *L. W. Hu*, Pennsylvania State College

Metals Joining in the Transformer Industry, by *Lawrence D. Jennings*, Westinghouse Electric Corp.

2:30 p.m.

Furnace Performance Factors—Fuel (VII)

Furnace Heat Absorption in a Spreader-Stoker-Fired Steam Generator, Part 1—Furnace Heat-Absorption Efficiency as Shown by Enthalpy of Gases Leaving the Furnace, by *J. W. Myers* and *R. C. Corey*, United States Bureau of Mines.

Furnace Heat Absorption in a Spreader-Stoker-Fired Steam Generator, Part 2—Variation in Furnace Heat-Absorption as Shown by Measurement of Temperature of Exposed Side of Furnace Tubes, by *F. G. Feeley, Jr.*, Union Carbide and Carbon Corp., and *Earle C. Miller*, Riley Stoker Corp.

Radiant Heat Transfer Vs. Wall-to-Tube Spacing in Radiant Superheaters, by *Robert Reed*, John Zink Co.

2:30 p.m.

High Temperature Steam Generation—Power (VIII)—Effect of Temperature on Metals

Laboratory Investigation of Superheater Tubing Materials in Contact With Synthetic Combustion Atmospheres at 1350 F, by *C. J. Slunder, A. M. Hall*, and *J. H. Jackson*, Battelle Memorial Institute.

Resistance of Cast-Fe-Cr-Ni Alloys to Corrosion in Oxidizing and Reducing Flue-Gas Atmospheres, by *J. H. Jackson, C. J. Slunder*, Battelle Memorial Institute, *J. T. Gow*, Electric Steel Foundry Co., and *O. E. Harder*, Battelle Memorial Institute.

Corrosion of Mercury Boiler Tubes During Combustion of Heavy Residual Oil, by *A. M. Hall*, Battelle Memorial Institute, *D. Douglas*, Hartford (Conn.) Electric Light Co., and *J. H. Jackson*, Battelle Memorial Institute

Thermal Shock and Other Comparison Tests of Austenitic and Ferritic Steels for Main Steam Piping—A Summary Report, by *W. G. Schreits* and *W. C. Stewart*, U. S. Naval Engineering Experiment Station

2:30 p.m.

Production Engineering(VII)—Education (I)

The Fifth Year and Thesis Programs at General Motors Institute, by *Charles J. Tull, Jr.*, General Motors Institute

Guideposts in Production Engineering Education, by *Seymour Mellman*, Columbia University

2:30 p.m.

American Rocket Society (I)

A Survey of Combustion Instability in Liquid-Propellant Rocket Engines, by *R. S. Levine* and *R. B. Lawhead*, North American Aviation, Inc.

A Simplified Combustion-Analysis System, by *R. Neumann, D. Dembrow, W. Berl*, and *R. Prescott*, Johns Hopkins University

Combustion Studies in Rocket Motors, by *K. Berman* and *S. H. Cheney*, General Electric Co.

7:30 p.m.

Banquet

THURSDAY, DECEMBER 4

8:00 a.m.

Registration

9:30 a.m.

Applied Mechanics (VIII)

On Turbulent Flow Between Parallel Plates, by *S. I. Pai*, University of Maryland (Paper No. 52—A-5)

Water-Channel Analog to High-Velocity Combustion by *A. K. Oppenheim*, University of California (Paper No. 52—A-3)

Unsteady Radial Flow of Gas Through Porous Media, by *R. Jenkins* and *J. S. Aronofsky*, Magnolia Petroleum Co.

9:30 a.m.

Railroad (IV)

Survey—Progress in Railway Mechanical Engineering, 1951–1952, by *T. F. Perkinson*, General Electric Co.

A Method for Determining Stresses and Vibration Data in Brake Beams Under Actual Operating Conditions, by *R. B. Cottrell*, American Steel Foundry. (Paper No. 52—A-11)

9:30 a.m.

Wood Industries (I)—FPRS (I)

Control of Sunken Glue Joints, by *F. M. Selbe*, Forest Products Laboratory

Cutting-Knife Problems, by *L. A. Patronsky*

Contour Sanding, To be announced

Surface Sanding, by *G. De Nambo*

9:30 a.m.

Education (III)—Management (VII)—Junior (VII)

The Professional Man and His Lay Client, by *C. J. Freund*, University of Detroit

Developing Professional Consciousness in the Young Engineer in Industry, by *R. E. Burton*, E. I. du Pont de Nemours & Co., Inc.

9:30 a.m.

Boiler-Feedwater Studies

Contamination of Condensate by Heat-Exchanger Tube Alloys, by *J. D. Ristroph*, Virginia Electric & Power Co., and *E. B. Powell*, Stone & Webster Engineering Corp.

Experimental Studies of Boiler-Tube Metal Temperatures, by *C. Jacklin*, National Aluminate Corp.

Conversion of a Two-Stage Hot-Process Water Softener From Hot Lime-Soda-Phosphate to Hot Lime-Zeolite, by *G. H. Gowdy*, The Neges Service Corp. of the New England Gas & Electric System, *S. B. Applebaum*, Cochrane Corp.

9:30 a.m.

Fluid Meters (III)

The Venturi as a Meter for Gas-Solids Mixtures, by *Leonard Farbar*, University of California

Experimental Evaluation of Expansion Factors for Steam, by *J. W. Murdock* and *C. J. Foltz*, U. S. Naval Boiler and Turbine Laboratory Naval Base

9:30 a.m.

Power (IX)—Fuels (VIII)

Recent Development in the Use of Pellets for the Removal of Slag Deposits in Boiler Furnaces, by *W. F. Cantieri*, Diamond Power Specialty Corp.

The Use of Additives to Reduce Oil-Slag Deposits, by *E. C. Huge*, The Babcock & Wilcox Co., and *Robert B. Lee*, Florida Power & Light Co.

9:30 a.m.

Gas Turbine Power (VII)—Hydraulics (VI)

Panel

Thermodynamics of Turbomachines, by *A. J. Stepanoff*, Ingersoll Rand Co.

Aerodynamic Design of Efficient Two-Dimensional Channels, by *J. D. Stanitz*, Lewis Flight Propulsion Laboratory

9:30 a.m.

Lubrication (II)—Machine Design (VIII)

Panel

High Lead-Content Bearings, by

Earl Jackson	General Electric Co.
E. Crankshaw	The Cleveland Graphite Bronze Co.
John Boyd	Westinghouse Electric Corp.
A. F. Underwood	General Motors Corp.

9:30 a.m.

Rubber & Plastics (I)

Mechanical Properties of Hypalon S-2, by *A. Stockfleth*, E. I. du Pont de Nemours & Co., Inc.

Mechanical Applications of Flowed-In Gaskets, by *W. M. Rand, Jr.*, Dewey and Almy Chemical Co.

The Room-Temperature Compounding Process, by *W. B. Wines*, Western Electric Co.

9:30 a.m.

American Rocket Society (II)

Ignition of Fuel With Nitric Acid, by *K. C. Holliday*, Bendix Aviation Corp.

Chemical Kinetics and Heat Transfer in Rocket Motors, by *H. Wise*, California Institute of Technology

The Effect of Chemical Reactions Upon Predicted Performance of Rocket Motors, by *R. F. Potter*, Bell Aircraft Corp.

The Nitric Acid-Ammonia Propellant Combination for Rockets, by *R. J. Thompson*, M. W. Kellogg Co.

12:15 p.m.

Members & Students Luncheon

12:15 p.m.

Wood Industries Luncheon

Presiding: *Frank Parrish*

Speaker: *John C. Taylor*, American Houses

Subject: **Trends in House Construction**

2:30 p.m.

Railroad (V)—Gas Turbine Power (VIII)—AIEE

Gas-Turbine Electric Locomotives on the Union Pacific, by *A. H. Morey*, General Electric Co., and *F. Fahland*, Union Pacific Railroad Co.

Operation of Westinghouse-Baldwin Gas-Turbine Locomotive, by *T. L. Weybrew, C. Kerr, Jr.*, and *T. J. Pais*, Westinghouse Electric Corp.

2:30 p.m.

Wood Industries (II)—FPRS (II)

The General Finishing Picture, by *Thomas Kelly*

Alkyd Resins, by *W. S. Robertson*, E. I. du Pont de Nemours & Co., Inc.

Lacquer Finishes, by *F. H. Thomas*, Sherwin Williams Co.

New Finishing Materials, by *W. A. McKim*, Reliance Varnish Co.

2:30 p.m.

Education (III)

Panel—Industry's Stake in the Secondary School

M. D. Hooven	Public Service Gas & Electric Co.
J. H. Davis	Stevens Institute of Technology
Morris Meister	Bronx High School of Science

Fluid Meters (IV)

2:30 p.m.

Symposium

Inferential Flowmeter Measuring Tolerances and Errors, by *Andre L. Jorrissen*, Cornell University

Discussers

I. O. Miner	Builders-Providence Inc.
L. K. Spink	The Foxboro Company
H. S. Bean	U. S. Department of Commerce
R. E. Sprenkle	Bailey Meter Co.
W. S. Pardoe (Retired)	Merion Station, Pa.

2:30 p.m.

Power (X)

Panel

2:30 p.m.

Machine Design (IX)

Multiple Pressures in a Single Hydraulic Circuit, by *H. L. Stewart*, Logansport Machine Co., Inc.

Lateral Forces on Hydraulic Pistons, by *J. F. Blackburn*, Massachusetts Institute of Technology

2:30 p.m.

Cutting Fluids (II)—Metal Cutting (II)—Production Engineering (VIII)—Lubrication (III)

Metal Cutting, Chatter, and Its Elimination, by *R. S. Hahn*, The Heald Machine Co.

A Standard Procedure for Evaluating the Tool Life of Single-Point Sintered Carbide Tools, by *O. W. Boston*, University of Michigan

A Lathe Test for the Evaluation of Cutting Fluids, by *J. D. Oathout, W. L. Howell, J. P. Hamer*, and *H. L. Leland*, Standard Oil Development Co.

2:30 p.m.

Rubber & Plastics (II)

Measurement of Tread Wear, by *R. D. Stiehler, G. G. Richey*, and *J. Mandel*, National Bureau of Standards

Creep of Neoprene in Shear Under Static Conditions: Ten Years, by *W. Newlin Keen*, E. I. du Pont de Nemours & Co., Inc.

Selected Rubber References for the Mechanical Engineer—July, 1951–June, 1952, by *Leora Straka*, Goodyear Tire & Rubber Co., and *Betty Jo Clinebell*, University of Akron

2:30 p.m.

American Rocket Society (III)

Application of the Ramjet to Aircraft Propulsion, by *M. S. Harned*, Marquardt Aircraft Co.

Theoretical and Experimental Investigation of a Valveless Intermittent Engine, by *J. Logan*, Cornell Aeronautical Laboratory

Application of Analog Techniques to Control Design for Aircraft Engines, by *W. C. Schaffer*, Wright Aeronautical Corp.

Applications of Pyrometry to Rocket Testing, by *E. Cartolio*, North American Aviation Corp.

Determination of Pressure Time Curve for Motors of Gun-Launched Rockets, by *E. F. Lype*, Armour Research Foundation

6:30 p.m.

Wood Industries Dinner

7:00 p.m.

American Rocket Society Dinner

8:00 p.m.

Fluid Meters (V)

The Pitot-Venturi Flow Element—Water-Service Performance Data, by *Henry W. Stoll*, Taylor Instrument Companies

Measurement of Pulsating Flow With Propeller Turbine-Type Meters, by *R. B. Dowdell* and *A. H. Liddle, Jr.*, Builders-Providence, Inc.

Research in Orifice Metering. (A motion picture by courtesy of Daniel Orifice Fitting Co.)

8:00 p.m.

Power (XI)—Management (VIII)

Symposium—Industrial Power-Plant Costs

C. S. Robinson	E. I. du Pont de Nemours & Co., Inc.
T. A. Fearnside	Stone & Webster
J. Campbell	E. I. du Pont de Nemours & Co., Inc.
F. G. Feely, Jr.	Carbide & Carbon Chemicals Co.

8:00 p.m.

Machine Design (X)

Pressure-Flow Relationships for a 4-Way Valve, by *J. F. Blackburn*, Massachusetts Institute of Technology

Notes on the Hydraulic Wheatstone Bridge, by *J. F. Blackburn*, Massachusetts Institute of Technology

8:00 p.m.

Metal Cutting (III)—Cutting Fluids (III)—Production Engineering (IX)

Power Required by Carbide-Tipped Face-Milling Cutters, by *W. W. Gilbert, O. W. Boston*, and *A. A. Siekmann*

Practical Application and Problems in Abrasive Belt Grinding, by *H. W. Bennett*, Behr-Manning Division

Mechanically Mounted Cutting Elements of Cemented Carbides, by *W. L. Kennicott*, Kennametal, Inc.

8:00 p.m.

Lubrication (IV)

Solution of the Reynolds Equation for Slider-Bearing Lubrication—Effect of Temperature on the Viscosity—(4), by *J. F. Osterle, A. Charnes*, and *Edward Saibel*, Carnegie Institute of Technology

Solution of the Reynolds Equation for Slider-Bearing Lubrication—The Sector Thrust Bearing—(5), by *A. Charnes, Edward Saibel,* and *S. C. Ying,* Carnegie Institute of Technology

Solution of the Reynolds Equation for Slider-Bearing Lubrication—The Parallel-Surface Slider Bearing Without Side Leakage—(6), by *J. F. Osterle, A. Charnes,* and *Edward Saibel*

FRIDAY, DECEMBER 5

8:00 a.m.

Registration

9:30 a.m.

Textile Engineering (I)

Artificial Crimping of Heavy Nylon Filament for Hosiery and Sweater Use, by *Lee Rainard,* Alexander Smith Inc.

Effects on Structure on Some Functional Properties of Textile Fabrics, by *L. I. Wiener,* U. S. Army

9:30 a.m.

Wood Industries (III)—FPRS (III)

Trends in Structural Practice, by *F. Powell Forbes*

New Aspects of Stock Millwork, To be announced

Use of Cut-Stock in Building Practice, by *Forest Beil*

Getting the Most Out of Flooring, by *Herb McKean*

Prefinished Wall Panels, by *Bob Berglin,* Wood Paneling Inc.

9:30 a.m.

Power (XII)—Machine Design (XI)

Development in Design of Turbine-Generator Lubrication and Control-Oil System, by *George H. Newton,* Westinghouse Electric Corp.

Turbogenerator Lubricating Systems With Emphasis on Safety and Simplification, by *James J. Gibney, Jr.,* General Electric Co.

9:30 a.m.

Rubber & Plastics (III)

The Effect of Biaxial Stretching on the Crazing Resistance of Transparent Acrylic Plastics, by *G. M. Kline* and *A. Axilrod,* National Bureau of Standards

Stress Crazing of Plastics, by *J. A. Sauer* and *C. C. Hsiao,* Pennsylvania State College

Design Factors for Injection-Molding Heating Cylinders, by *Gerald D. Gilmore,* Dow Chemical Co.

9:30 a.m.

American Rocket Society (IV)

The Evaluation of Competing Rocket Power-Plant Components for Two-Stage Long-Range Vehicles, by *A. L. Feldman,* Consolidated Vultee Aircraft Corp.

Rockets Behind the Iron Curtain, by *G. P. Sutton,* North American Aviation, Inc.

Liquid-Propellant Booster Rockets for Guided Missiles, by *I. P. Brown,* M. W. Kellogg Co.

Optimum Performance for Rockets With Fixed Propellant Volume and Using High-Density Additives, by *J. Lorrell* and *A. R. Hibbs,* California Institute of Technology

Hydrogen Peroxide, Problems and Operating Procedures, by *G. N. Meckert,* Edwards Air Force Base

9:30 a.m.

Production Engineering (X)

The Theory of Mechanical, Electrical, Electronics, and Air Gaging, by *W. Fay Allen,* The Sheffield Corp.

Introduction to Principles of Pneumatic Gaging, by *D. B. Kirk,* Moore Products Co.

9:30 a.m.

Lubrication (V)

Experiments With Water Lubricated Tapered Land Thrust Bearings, by *M. Levinsohn*

Lubrication of Gyroscopes, by *J. E. Brophy* and *J. B. Roman*

Note on the Shear Stress in a Viscous Fluid in Motion, by *Frank R. Archibald*

12:15 p.m.

American Rocket Society Luncheon

Speaker: *Wernher von Braun,* Redstone Arsenal, Huntsville, Ala.

Subject: **The Importance of Satellite Vehicles in Interplanetary Flight**

12:15 p.m.

Textile Engineering Luncheon

Presiding: *F. D. Snyder*

Speaker: *Douglas Williams,* president, Douglas Williams Assoc., New York, N. Y.

Subject: **Employes' Attitudes and Productivity**

2:30 p.m.

Textile Engineering (II)—Management (IX)

Integrity in Production Engineering, by *N. M. Mitchell,* Barnes Textile Associates

Appraising the Operating Characteristics of Looms by Research, *Victor Separich,* Compton and Knowles Looms Works

2:30 p.m.

Wood Industries (IV)—FPRS (IV)

Panel

Materials Handling	*Paul Graham*
Seasoning	*Harry Rich*
Sawmilling	*Fred C. Simmons*
Finishing	*Robert M. Dean*
Plastics	*W. Burdette Wilkins*

2:30 p.m.

Power (XIII)—Machine Design (XII)—Lubrication (VI)

Applying Bearing Theory to the Analysis and Design of Pivoted Pad Bearings, by *John Boyd,* Westinghouse Electric Corp.

Oil Whip of Flexible Rotors, by *A. C. Hagg* and *P. C. Warner,* Westinghouse Electric Corp.

Segmental Thrust Bearing, by *Arthur B. Lahey,* Kingsbury Machine Works.

2:30 p.m.

Rubber & Plastics (IV)

Effects of Defects on Strength Properties of Plastic Laminates, by *B. G. Heebink,* and *A. A. Mohaupt,* Department of Agriculture, Forest Products Laboratory

Rigid Polyvinyl Chloride Pipes, Tubes, Rods, and Sheets for Corrosion Protection, by *George S. Laaff,* Bolta Co.

Selected Plastic References for the Mechanical Engineer—July, 1951–June, 1952, by *Helen Dickerman,* Monsanto Chemical Co.

2:30 p.m.

American Rocket Society (V)

Team of Engineer and Physiologist in Rocketry, by *E. B. Konecci,* USAF School of Aviation Medicine

Principles of Planetary Ecology, by *H. Strughold,* USAF School of Aviation Medicine

Escape and Survival in the Border Zone of Space, by *F. Haber,* USAF School of Aviation Medicine

Establishment of Large Satellites by Means of Small Orbital Carriers, by *K. A. Ehricke,* Redstone Arsenal

2:30 p.m.

Production Engineering (XI)

Gaging and Sorting Electronically, by *A. C. Sanford,* Federal Products Co.

Electronics—Dimensional Gaging, by *Charles W. Williams,* Graham-Mintel Instrument Co.

WOMEN'S PROGRAM

Registration

Sunday, November 30

3:00 p.m. Reception at Engineering Woman's Club—to 6:00 p.m.

Monday, December 1

12:15 p.m. President's Luncheon at Hotel Statler

4:00 p.m. Tea Dance at Hotel Statler—to 7:00 p.m.

9:00 p.m. Coffee Hour and Western movies—Hotel Statler

Tuesday, December 2

9:00 a.m. Breakfast at B. Altman's

12:00 noon Luncheon, Hotel Beekman—and UN Tour

Wednesday, December 3

9:00 a.m. President's Breakfast at Hotel Statler

12:30 p.m. Annual Luncheon and Fashion Show at Hotel Pierre

7:00 p.m. Banquet

Thursday, December 4

10:30 a.m. Tour of *S.S. America* and Buffet Luncheon—Town Hall Club

Refrigeration Engineering Conference

A JOINT meeting with The American Society of Mechanical Engineers and symposiums on commercial and industrial coil defrosting, insulation, room air conditioners, also product planning and styling of domestic refrigerators, form the high lights of the 48th annual meeting of the American Society of Refrigerating Engineers, will be held Nov. 30-Dec. 3 at the Hotel Commodore, New York, N. Y.

In addition, there will be an entire session devoted to a round-table discussion of the various methods of automobile air conditioning that are now being used by several prominent manufacturers.

An innovation in ASRE meetings, introduced at the meeting last June in Atlanta—an exhibit of technical-research processes employed in the refrigeration industry will be continued at this session.

One entire session will be devoted to papers and a discussion of food processing led by well-known authorities in the field of refrigerated foods.

For the benefit of those particularly interested in the application of refrigeration equipment, papers are now being considered by the Program Committee on refrigeration in the textile, rubber, and brewery industries.

The joint meeting with ASME, the Annual Meeting of which will be held at the Hotel Statler, Nov. 30–Dec. 5, New York, N. Y., will take place December 1st at the Commodore Hotel and will be presided over jointly by R. C. Jordan, vice-president, ASRE, and E. L. Knoedler, chairman, Process Industry Division, ASME. Papers of interest to members of both societies will be presented.

One session that promises to be of unusual interest to refrigerating engineers is the Symposium on Commercial and Industrial Defrosting. Five prominent refrigeration engineers will each present a discussion of one or more methods of defrosting.

The Domestic Refrigerator Engineering Conference, always a popular feature at ASRE conventions, this year promises a most unusual and interesting program requiring an all-day session, the first half of which will include talks by prominent engineers discussing what the future holds for the industry, followed by a round-table discussion in the afternoon on Industrial Design—its history, functions, and relationship of "Consultant" to "Company" industrial designers.

Plans for the Insulation and Air-Conditioner Conferences also are rapidly being completed.

Power-Plant Engineering Objectives Reflected in Plans for Power Show

EXTRAORDINARY developments in power plants are forecast in plans for the 20th National Exposition of Power and Mechanical Engineering to run in New York, N. Y., through the first week in December. Technical advances of revolutionary nature will be under review at that time at the Annual Meeting of The American Society of Mechanical Engineers, which will be held at the Hotel Statler, Nov. 30–Dec. 5, under whose auspices the Power Show is held, but their reduction to practice will depend very largely on the work of specialists, whose latest achievements will be displayed currently in Grand Central Palace.

Leaders in the engineering profession foresee a doubling of gas consumption within the next decade or two, and competitive improvements in the treatment and combustion of coal to enhance the position of that fuel in regions where it is readily available. More and larger superpower stations are promised for the future and far more economical generation of power in industrial plants, some of which rival the great electrical generating stations in size. All manner of improvements in power-plant economy are being fostered to offset the rising tide of power costs, and many of these will immensely benefit the economy of the older and smaller installations.

Of no less moment is the prospect of rapid advancement of the gas turbine, which, it is now seen, will occupy a dominant position in favorable fields, and which promises to supplement the internal-combustion piston-driven engine in automotive power plants, if not to supplant it in the air.

Advance information on some of the displays at the Palace suggests the close touch of the specialists with the scientists and new engineering-project developers. One exhibitor will show centrifugal castings of special alloys for jet engines, including a difficult silicon-iron bronze cage blank, cast and hot-worked, for antifriction bearings to be used in jet aircraft. In this display will be finish-machined centrifugal castings ranging in diameter from 1 in. to 42 in. OD, and in length one-half inch to 66 inches.

A manufacturer of cast and forged-steel products is just bringing out a new and "completely revolutionary" type of cast-steel valve. Another exhibit will be focused on a high-pressure gate valve with breech-lock seal-welded body-bonnet connection, typical of the high-pressure, high-temperature equipment the exhibitor is furnishing to steam generating stations throughout the country. Some of the installations of this type are run at temperatures so high that the valves take on a dull red glow.

Development of a new four-inch tube by a manufacturer of dust collectors permits smaller-sized equipment to be assembled, which can be installed in plants where space limitations have prevented the use of such equipment in the past. The exhibit showing this new item will feature an animated display showing fly ash being separated for refiring. A type of dust collector, first exhibited in this country at the last Power Show, will be demonstrated in action, showing how dust is collected through the aid of 2000 slotted perforations in each tube. An installation of this type has recently gone into use on a boiler capable of converting 500 tons of water per hour into steam. It handles 450,000 cfm of flue gas at 325 deg F with a draft loss of only 0.70 in. wg, and is installed ahead of an electrostatic precipitator, which is intended to trap the small proportion of fly ash that escapes the first collector.

Some exhibitors will feature the variety of materials in which the specialties which they produce may be obtained, as tube fittings in brass, steel and stainless, but now also in aluminum. Others emphasize the range of capacities available, as steam traps for pressures from 150 to 2400 psig. There are numerous specialties among the more than three-hundred exhibits at the Power Show, such as a catalytic process for treating industrial and potable water without the use of chemicals, which has the function of retarding the formation of scale and gradually, over a period of time, reducing scale and corrosion. A similar instance is the exhibit of a complete system for purifying, dehydrating, and degasifying insulating oil in the field or at the central-station location.

There will be numerous exhibits of scientific interest and advanced technology. Examples are those of the electron microscope and an adaptation of television to industrial uses involving, among others, the observation of hazardous reactions from remote, safe locations.

ASME-AIME to Hold Fifteenth National Fuels Conference

Headquarters: Bellevue-Stratford Hotel, Philadelphia, Pa., Oct. 30–31

THE Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers, will participate in a National Fuels Conference on Oct. 30 and 31, 1952. The Bellevue-Stratford Hotel, Philadelphia, Pa., will be headquarters for all sessions of the conference.

The tentative program announced by A. W. Thorson, general chairman, calls for four sessions. A Domestic Stoker Symposium, and a session on coal preparation will be presented under the auspices of the AIME. ASME plans talks on the use of anthracite in domestic and central station applications; and a session on the handling of coal and ash with the related problems of dust collection.

Additional features will include the presentation of the 1952 Percy Nicholls Award to Harry F. Yancey, of the Bureau of Mines, The University of Washington, at the Banquet on Thursday evening, and the showing of "Powering America's Progress," a recent film release of the Bituminous Coal Institute.

This is the fifteenth conference in a series which began in 1937 to provide a forum before which coal users and coal producers could discuss the problems encountered in their operation and the progress made in the industry.

The tentative program follows:

THURSDAY, OCTOBER 30

8:30 a.m.

Registration

10:00 a.m.

Session I

Domestic Stoker Symposium

Service and Operating Experiences on Two Models of Preoxidizing Domestic Stokers, by *T. S. Spicer, R. J. Grace,* and *C. C. Wright,* The Pennsylvania State College

Comprehensive Studies of Draft Arrangements for Domestic Stokers, by *Reginald I. Bush* and *Charles H. Sawyer,* Coal Division of Eastern Gas and Fuel Associates

New Type of Domestic Anthracite-Burning Equipment, by *Raymond C. Johnson,* Anthracite Institute

12:45 p.m.

Luncheon

Presiding: *W. E. Reaser,* chairman, Fuels Division, ASME *A. L. Barrett,* chairman, Coal Division, AIME

Film Presentation: **Powering America's Progress,** by Bituminous Coal Institute

2:30 p.m.

Session II

Use of Anthracite in the Sunbury Station, by *C. H. Frich,* Pennsylvania Power and Light Co.

Paper on Domestic Use of Anthracite, by *R. C. Johnson,* Anthracite Institute

4:00 p.m.

Executive Committee, Fuels Division, ASME
Executive Committee, Coal Division, AIME

6:00 p.m.

Cocktail Hour

7:00 p.m.

Banquet

Toastmaster: *J. E. Tobey,* president, Appalachian Coals, Inc.

Presentation of Percy Nicholls Award for 1952 to *H. F. Yancey,* Bureau of Mines, University of Washington
Speaker: *A. A. Potter,* Purdue University
Subject: **Let's Look Ahead**

FRIDAY, OCTOBER 31

8:30 a.m.

Registration

10:00 a.m.

Session III

Preparation

Fundamental Principles Applying to the Design

and Operation of a Fine-Anthracite-Coal Plant at the Coaldale Colliery, by *W. T. Turrall* and *M. J. Cook*, Lehigh Navigation Coal Co.

Use of Oil in Coal Preparation, by *John L. Stewart*, Ashland Oil and Refining Co.

Mechanics of Oil Treatment of Coal, by *C. E. Berry* and *J. H. Dawson*, Viking Machinery Sales Co.

A New Method of Spraying Oil at the Georgetown Plant, by *Alfred F. Meger*, Hanna Coal Co.

12:30 p.m.

Luncheon

No formal luncheon has been planned. It is suggested that members and guests make their own arrangements.

2:30 p.m.

Session IV

A Study of the Problem of Coal Freezing, by *C. C. Wright* and *E. E. Peterson*, The Pennsylvania State College.

Cost of Coal and Ash-Handling Equipment, by *C. A. Marshall*, Fairmont Coal Bureau.

Dust-Collection Practice in Europe, by *Professor Ter Linden*, Delft University.

5:00 p.m.

Joint Conference Committee Meeting

Women's Program

No formal program has been planned for the women attending the Conference.

People

ASME Elects Four Fellows

THE American Society of Mechanical Engineers has honored four of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who, by virtue of their contribution to their profession and to the Society, were so honored are:

A. P. Beutel

A. P. BEUTEL is director, vice-president, and general manager of the Texas Division, The Dow Chemical Company.

Mr. Beutel was graduated from Case Institute of Technology with a BS degree in 1914; DE, 1942. He married Belle B. Armstrong, April 16, 1916, and they have two sons and one daughter. During his 36 years with The Dow Chemical Company he has acquired wide recognition for leadership and development of welding techniques, and in the first use of the coated rod needed in the early development of extreme high-pressure, high-temperature chemical process equipment. He was responsible for numerous projects such as the construction of the Ethyl-Dow plant at Wilmington, N. C., and the Dow Iodine plants in California.

His outstanding organization and engineering ability resulted in the further achievements of building the two large plants in the Texas Division, one at the mouth of the Brazos River in Freeport, Texas, and the 60 million D.P.C. Magnesium plant in Velasco where magnesium was poured six months from the time the ground was broken for construction.

Mr. Beutel was responsible for the development of a modern townsite, Lake Jackson, Texas, and was the motivating force behind further development of housing facilities to handle a tenfold population increase.

His other interests include such activities and duties as president of Dowell, Inc., of Tulsa, Okla.; counsel of Texas A&M Research Foundation; Regent of Lamar State College of Technology, of Beaumont, Texas, and director of the City National Bank of Houston. He organized and is president of Brazos Oil & Gas Company of Houston, Texas. He has been a member of ASME since 1929; among the other technical societies of which he is a member are: API, AIME, and ACS.

DR. A. M. GREENE, JR., VISITS AT THE UNIVERSITY OF MISSOURI

(*Left to right:* Leslie Cowan, vice-president, University of Missouri; Dr. Greene, dean emeritus, school of engineering, Princeton University; and H. O. Croft, Mem. ASME, dean, Missouri college of engineering. Since Dr. Greene's retirement at Princeton in 1940, he has been engaged in research and is writing a history of The American Society of Mechanical Engineers' Boiler Code, the first chapter of which was published in the July, 1952, issue of MECHANICAL ENGINEERING.)

Ralph D. Brizzolara

RALPH D. BRIZZOLARA, vice-president and engineering consultant, American Steel Foundries, Chicago, Ill., has made outstanding contributions as an engineering consultant and in the design and development of new manufacturing methods, equipment, and processes. In his 33 years with American Steel Foundries, Mr. Brizzolara has developed equipment for processes in manufacture of steel castings; created improved dust-collection methods; developed special-product testing equipment; and designed and built improved open-hearth furnaces and special heat-treating furnaces. He also developed several processes for making steel forgings and contributed to the design of innovations in machine tools and hydraulic machinery. Among other things he was responsible for designing, constructing, and equipping a large steel foundry in East Chicago, Ind., and the design of several steam-boiler plants. Mr. Brizzolara has also performed important engineering consulting service for the United States Steel Corporation and several other companies. In 1947 he made an economic survey of Brazil, Argentina, Uruguay, Chile, and Peru regarding need for additional manufacturing facilities. He has also analyzed the financial, product, physical, and market status and prospects of over five hundred companies during the past few years. He is civilian consultant to the Chief of Ordnance, U. S. Army, in the field of machine tools. He has served on many ASME committees and was chairman of the Standing Committee on Constitution and By-Laws, the Metals Engineering Division, and the ASME Chicago Section (1934–1935).

J. Calvin Brown

J. CALVIN BROWN, patent lawyer and consulting engineer, Los Angeles, Calif., has made outstanding contributions to engineering by his work as a patent lawyer and by his numerous addresses to engineering students and engineers throughout the United States and elsewhere. His work with the motion-picture industry, the aircraft industry, and others in patent litigation, as well as his work in The American Society of Mechanical Engineers, have all contributed to the advancement of the science of engineering. In this work with ASME, Mr. Brown was successively chairman of the ASME Southern California Section, 1941–1943; manager ASME, 1943–1944; vice-president ASME, Region VII,

1945–1949; and president ASME, 1950–1951. During his tenure as president he delivered over 168 addresses to engineering students and ASME sections throughout the United States, Canada, and Mexico. While vice-president he delivered many addresses to engineering students and to all sections in Region VII. His outstanding and continuous work for the advancement of the engineering profession has resulted in higher engineering standards and also increased activity and interest in the ASME. In 1951 he was cited as one who had advanced the standards of the patent profession, by the president of the American Patent Law Association, at the annual banquet which was held in Washington, D. C. He serves the Society as a member of the John Fritz Medal Board of Award; ASME representative on the Engineers Joint Council; and director, Centennial of Engineering, 1952, Chicago.

John W. Sheperdson

JOHN W. SHEPERDSON, who retired in 1952 as executive vice-president of the Morgan Construction Company, Worcester, Mass., has made outstanding contributions in the engineering of continuous hot-rolling mills for the production of wire rods, merchant bars, billets, skelp, and narrow strip. During his 36 years with this company he was in responsible charge of research, engineering, and initial operation of the company's continuous hot-rolling mills which are installed in all the major steel-producing countries of the world. During this period the company built and put into operation 94 continuous mills. Among the contributions to continuous hot-rolling for which he was responsible are the first four-strand continuous rod mill, that produced rods in 600-lb coils at the rate of 4500 fpm, the first continuous rod mill employing free looping stands between the roughing and finishing trains, development of roller twist guides, invention and development of automatic looping tables and a valve system permitting quick return and increased operating speed of steam flying shears, and development of the first successful electrically driven flying shear for dividing billets in motion as delivered by a billet mill. He also developed multipurpose continuous mills which combine flexibility with respect to size and type of product, with the high productivity and low conversion cost which are characteristics of the continuous mill. He holds over 35 patents.

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HERBERT HOOVER, Hon. Mem. ASME, received a gold medal award from the northwest engineers when they gathered in Portland, Ore., Aug. 9, 1952, for the Northwest Engineers Centennial. The Hoover award is in recognition of the former president's great contribution to engineering and the humanities.

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SIR GEOFFREY DE HAVILLAND, technical director, de Havilland Aircraft Company, Ltd., Hatfield, Hertfordshire, England, has been named recipient of the 1951 Daniel Guggenhiem Medal for "forty years of pioneering in military and commercial aircraft and the development of long-range jet transport."

E. G. BAILEY, past-president and Fellow ASME, was selected as an Honorary Member of the American Society of Civil Engineers.

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H. BIRCHARD TAYLOR, Fellow ASME, Philadelphia (Pa.) industrialist, engineer, and author, was named winner of the Elliott Cresson Medal of The Franklin Institute for his development of the single-runner vertical turbine, his patents, and his contributions to technical literature.

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R. J. S. PIGOTT, President ASME, will represent the Society on the occasion of the celebration of the Centennial Year of the Yale School of Engineering to be held on Oct. 24, 1952.

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OVID W. ESHBACH, dean of engineering, Northwestern University, was recently elected as president of the Western Society of Engineers for 1952-1953; CHARLES E. DE LAUW, first vice-president; JOHN F. SULLIVAN, Jr., Mem. ASME, second vice-president; and ALLAN E. BULLEY, treasurer. L. E. GRINTER, Mem. ASME, was among the newly elected trustees.

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LILLIAN MURAD, who was the first woman to receive a BChE degree from Pratt Institute when she was graduated in 1947, was recently elected as president of the Society of Women Engineers for 1952-1953.

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JOHN C. SEAL, of Cornell Aeronautical Laboratory, Inc., was the recipient of The 1952 Octave Chanute Award at the annual summer meeting of the Institute of the Aeronautical Sciences. There were two winners of The Thurman H. Bane Award for 1952: the late MAJOR PATRICK L. KELLY, USAF, and HENRY SEBLER, of the Air Force's Aero Medical Laboratory.

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EDISON L. WHEELER, of Wheeler Protective Apparel, Inc., was elected president of the Industrial Safety Equipment Association at their annual meeting, June 25–27, 1952, at the Homestead, Hot Springs, Va.

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ERNEST A. CRAWFORD, engineering supervisor of the Continental Paper Company, Ridgefield Park, N. J., has been selected president of the Bergen County Chapter, New Jersey Society of Professional Engineers.

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HARRY P. SPARKS, Mem. ASME, divisional vice-president of American Machine & Foundry Company's contract division, has been appointed to the Board of Examiners of the American Institute of Electrical Engineers for the administrative year beginning August 1, 1952.

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HENRY G. STRONG was elected chairman of the Refrigeration Industry Safety Advisory Committee (RISAC). Edward L. Hart became vice-chairman, and Robert L. Williams was re-elected treasurer.

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CHARLES PENROSE, Mem. ASME, vice-president, Day and Zimmermann, Inc., Philadelphia, Pa., and Honorary Vice-President for North America of The Newcomen Society of England, addressed the Dartmouth Newcomen Association on the anniversary of the death of Thomas Newcomen, August 16.

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T. H. WICKENDEN, Mem. ASME, vice-president in charge of development and research of The International Nickel Company, Inc., has been elected a member of the Welding Research Council of the Engineering Foundation for a three-year term beginning October 1.

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BURTON C. MALLORY, Fellow ASME, Stone and Webster, will represent The American Society of Mechanical Engineers at the Centennial Celebration of Tufts College on October 11.

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EDWIN L. HALL, director of the testing laboratories of the American Gas Association, Inc., will be awarded a Walton Clark Medal for his contributions to the gas industry in the United States by The Franklin Institute of the State of Pennsylvania.

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A. G. JENSEN, director of television research, of Bell Telephone Laboratories, Murray Hill, N. J., has been named recipient of the David Sarnoff Gold Medal Award by the Society of Motion Picture and Television Engineers.

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ROBERT F. MEHL, head, department of metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa., is the 1952 recipient of the American Society for Metals' Gold Medal. The 1952 ASM Medal for the Advancement of Research will go to CLEO F. CRAIG, president, American Telephone and Telegraph Company, New York, N. Y. Presentation of these two top awards will be the feature of the annual dinner of the ASM, Oct. 23, 1952, in the Grand Ballroom, Benjamin Franklin Hotel, Philadelphia, Pa.

ASME Membership as of May 31, 1952

Honorary Members	54
Fellows	375
Members	13,398
Associates	355
Juniors (33 and over)	3,240
Juniors (30–32)	1,882
Juniors (To the age of 29)	17,765
Total	37,069

Twelve Regional Student-Branch Conferences Close Eventful 1951-1952 Season

SEVENTEEN hundred student members of The American Society of Mechanical Engineers, representing most of the 137 student branches of the Society attended the 12 regional conferences held at colleges and universities all over the country in the four months from February to May of this year.

The conferences were marked by the keen enthusiasm and interest of the students toward their chosen profession. They provided an excellent forum for informal but lively discussions of problems currently facing student branches. Some of the problems which concerned the students were methods by which student membership could be increased in spite of an anticipated future reduction in enrollment, the lack of student participation in the Charles T. Main Award, and ways of stimulating closer co-operation between local sections and student branches and obtaining speakers for student meetings. The question of five-year students and the eligibility rule which eliminates students with degrees from participating in the conferences also came up for much discussion.

Student Papers High in Quality

Student papers were informative, high in quality of content and presentation, and judges reported close decisions in deciding the winners. In one case there was a tie for first place. The papers dealt with a wide variety of subjects illustrating the diversified interests of the students. The well-attended technical sessions indicate the importance of these conferences which provide students with the opportunity to speak in public and gives them a sense of responsibility toward their Society and their profession. Much credit for the success of the conferences is due the hosts for their hard work in arranging the excellent programs. Besides well-run technical sessions, students heard stimulating talks by local industrial and civic leaders and enjoyed interesting field trips to local industries.

More than 190 students from 17 colleges and universities from Maine to Connecticut attended the Region I conference at the University of Massachusetts. During the conference they toured the engineering facilities of the university and heard a talk by Prof. A. P. Linnell of Amherst College on "Interstellar Gas." In presenting the prizes, W. F. Thompson, vice-president, Region I, spoke of the function of the engineer as an industrial trainee, of the civic responsibilities of young engineers, and of the advantages of professional associations to young engineers.

At the Region II conference held at Columbia University, there was a tie for first place in the papers competition between Carl W. Hansen of New York University and David J. Steele of Polytechnic Institute of Brooklyn. First and second prizes were divided between the two contestants. T. A. Marshall, Jr., executive secretary, EJC Engineering Manpower Commission, addressed the students on "Engineers and Their Future." Next year's conference is scheduled to be held at the College of the City of New York.

Inspection trips to the University of Maryland engineering laboratories, The Naval Ordnance Laboratory, and the National Bureau of Standards; and an engineer's dance were among the events enjoyed by students at the Region III conference. The two-day conference held at the University of Maryland attracted students from 14 colleges and universities. Princeton University will serve as host next year.

The scarcity of competent young design engineers has now assumed serious proportions, Colin Carmichael, editor, MACHINE DESIGN, told student engineers at the Region IV conference. Speaking on "Opportunities in Design," Mr. Carmichael described the work of the machine designer, his qualifications, and his chances for advancement. Students from all over the Southeast attended the conference held at Raleigh, N. C., with Duke University and North Carolina State College acting as joint hosts. Next year's conference is set for the University of Florida in conjunction with the 1953 Regional Administrative Committee Meeting.

The Region V conference held at the University of Akron had the largest attendance. More than 260 Midwest students heard an inspiring address by R. S. Wilson, vice-president, The Goodyear Tire and Rubber Company, on why "It Pays to Be a Professional." After a luncheon given by the Firestone Tire and Rubber Company, students were taken on a tour of the tire plants and the research laboratory. The man-miles cup at this conference went to the University of Detroit. Ohio State University will be host at next year's conference to be held concurrently with the ASME Spring Meeting.

Region VI Holds Two Conferences

Two features of the Region VI Southern Tier conference were an address by W. A. Hanley, past-president, ASME, on "Civic Responsibility in This Year 1952," and day-long inspection tours of the plants of the Link-Belt Company. Students from 13 colleges attended the conference held on the campus of Rose Polytechnic Institute. Host college for 1953 is the University of Louisville.

Michigan College of Mining and Technology was host at a very successful Region VI Northern Tier conference. Prof. L. L. Amidon, Mem. ASME, South Dakota State College, delivered the banquet address. He stressed the point that education is not to teach students to design a particular device or memorize certain formulas, but to think, so that they can produce machines and cultivate ideas that have never before been investigated. A birling exhibition by the Girard Brothers, former world champions in this ancient art of log rolling, and field trips to the Keweenaw Peninsula and local mines concluded the meeting.

Ways by which student membership could be increased in spite of an expected decline in engineering enrollment at the junior and senior-year level were discussed extensively at the Region VII Pacific Southwest conference held at Stanford University. Next year's host will be the University of Utah.

"The Complete Engineer," was the subject of an address by James McGivern, dean, college of engineering, Gonzaga University, at the Region VII Pacific Northwest conference. Another speaker, Miles Patrick, Jun. ASME, of the General Electric Company, Richland, Wash., gave students an over-all picture of

REGION VII, PACIFIC NORTHWEST SIXTEENTH ANNUAL STUDENT-BRANCH CONFERENCE HELD AT UNIVERSITY OF IDAHO AND STATE COLLEGE OF WASHINGTON, MAY 1–3, 1952

the mechanical-engineer's problems and possibilities in the nuclear-energy field. This conference was held jointly at Washington State College, Pullman, Wash., and the University of Idaho, Moscow, Idaho. The next conference was tentatively set for the University of Washington.

Region VIII Holds Three Meetings

An inspiring address by Carl J. Eckhardt, vice-president, Region VIII, on "An Engineer's Aspirations in a Paradoxical Era," was one of the outstanding features of the Region VIII Northern Tier conference at the University of Arkansas.

A barbecue and a field trip to the Mansfield Dam and Power Plant on the Colorado River were two high lights of the two-day Region VIII Southern Tier conference held at the University of Texas. Two-hundred students from eight Region VIII schools attended.

The 1953 conference is set for The Rice Institute, Houston, Texas.

The Region VIII Rocky Mountain Tier conference was held in conjunction with the third annual meeting of ASME Region VIII in Denver, Colo. Students met in joint session with the regular members. Awards for the outstanding student papers were made at a joint member-student luncheon. Students also enjoyed inspection tours of the Gates Rubber Company and the Reclamation Engineering Center.

The list of prize-winning papers and authors follows:

1952 ASME Regional Student Conference Prize Winners

REGION I, NEW ENGLAND, UNIVERSITY OF MASSACHUSETTS, AMHERST, MASS., MAY 2–3, 1952

Attendance: 198 — Papers Presented: 11

Prize	*Recipient*	*Title of Paper*	*College*
First	Stephen W. Tsai	Preparation of Three-Dimensional Photoelastic Models	Yale University
Second	Herbert J. Hollberg	Filtration of Swimming-Pool Water by the Use of the Diatomaceous Earth Filter	University of Rhode Island
Third	Merle S. Day	Supercharging the Ford V-8 Engine	Clarkson College of Technology
Fourth	Edward T. Pitkin	An Apparatus for Recording the Vibrations of a Single Disk on a Shaft	University of Connecticut
Old Guard	George B. Milliard	Color Conditioning for Industry	Tufts College

REGION II, EASTERN, COLUMBIA UNIVERSITY, NEW YORK, N. Y., MAY 10, 1952

Attendance: 115 — Papers Presented: 8

Prize	*Recipient*	*Title of Paper*	*College*
Tie (First)	Carl W. Hansen	Radioactive Traces of Friction	New York University
Tie (Second)	David J. Steele	A Differential Calculating Machine	Polytechnic Institute of Brooklyn
Third	Gerald A. Levine	Theoretical Analysis of a New Gas-Turbine Cycle	College of the City of New York
Fourth	Ned B. Sluyter	Spring Design	Newark College of Engineering
Old Guard	Mario P. Massolo	Development of the Lead-Sulphide Cell as a Flame Detector	Polytechnic Institute of Brooklyn Evening School

REGION III, ALLEGHENIES, UNIVERSITY OF MARYLAND, COLLEGE PARK, MD., APRIL 18–19, 1952

Attendance: 156 — Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Michael J. Baczar	The Pilot's Ejection Seat	Drexel Institute of Technology
Second	Ronald E. Adler	Industrial Ultrasonics	U. S. Naval Academy Midshipman School
Third	Robert T. Langmack	The Design of a Ninety-Foot Radar Antenna	University of Maryland
Fourth	Otto T. Muller Firard	Temperature Measurements in Fluids	University of Rochester
Fifth	Thomas Coughlin	The Design of a Radiant-Heat System	Lafayette College

REGION IV, SOUTHERN, DUKE UNIVERSITY AND NORTH CAROLINA STATE COLLEGE, RALEIGH, N. C., MARCH 30–APRIL 1, 1952

Attendance: 190 — Papers Presented: 12

Prize	*Recipient*	*Title of Paper*	*College*
First	George Detwiler	Flutter in Ramjet Helicopter Rotors	Duke University
Second	Thomas R. McConnell	High Compression in Gasoline Engines	University of South Carolina
Third	William C. Burns	Corrosion Problems in Internal-Combustion-Engine Cooling Systems	North Carolina State College
Fourth	Frank McAbee	The Vanishing Clutch	University of Alabama
Fifth	Arthur R. Riley	Crude-Oil Storage Problems on Oil-Well Drilling Platforms in the Gulf of Mexico	Mississippi State College
Old Guard			

REGION V, MIDWEST, UNIVERSITY OF AKRON, AKRON, OHIO, APRIL 28–29, 1952

Attendance: 265 — Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	Ray Friant, Jr.		West Virginia University
Second	Glenn L. Smith	Feasability of Adapting an Automatic Dynamic Balance to an Airplane Propeller	University of Cincinnati
Third	Ernest O. Doebelin		Case Institute of Technology
Fourth	John M. Lawrence	Nonmetallic Bearings	University of Toronto
Old Guard	William E. Reinsel	A Proposed Application of Variable Viscosity Suspensions to Automotive Torque Converters	University of Detroit

REGION VI, NORTHERN TIER, MICHIGAN COLLEGE OF MINING & TECHNOLOGY, HOUGHTON, MICH., MAY 12–13, 1952

Attendance: 215 — Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Charles G. Faris	A Method of Reducing the Cost of Machining Long Slender Shafts	South Dakota School of Mines
Second	Wilfred J. Lepeska	Applying Moral Concepts to Engineers	Marquette University
Third	Howard Peterson	Automobile-Chassis Design	North Dakota State College
Fourth	Robert Stanton	The Future of the Foundry Industry for Mechanical Engineers	University of Wisconsin
Old Guard	Richard D. Morgan	Perpetual Motion	Illinois Institute of Technology

REGION VI, SOUTHERN TIER, ROSE POLYTECHNIC INSTITUTE, INDIANAPOLIS, IND., MAY 8–9, 1952
CENTRAL INDIANA SECTION

Attendance: 125 — Papers Presented: 13

Prize	*Recipient*	*Title of Paper*	*College*
First	James R. Hunter	Automotive-Generator Regulation	Purdue University
Second	Parry Barnes, Jr.	Octane Snubber	University of Missouri
Third	Robert Norling	Photoelasticity—What, Why, How?	Bardley University
Fourth	Arthur Pederson	Increase in Qualities of Casting Through the Use of Mineral Pearlite	University of Illinois—Navy Pier Division
Old Guard	Abner Pike	The Hilsch Tube	University of Louisville

REGION VII, PACIFIC NORTHWEST, UNIVERSITY OF IDAHO, MOSCOW, IDAHO, MAY 1–3, 1952

Attendance: 131 — Papers Presented: 10

Prize	*Recipient*	*Title of Paper*	*College*
First	Nobuo Yutani	The Hot Box	University of Washington
Second	Wes Towner	Catenary Aircraft-Warning Light and Installing Trolley	Washington State College
Third	Alex Kerr	A Photoelastic Analysis of Prestressed Bolts	Oregon State College
Fourth	David W. Blair	The Operation of an Experimental Heat Pump in Wet Clay Soil	Oregon State College
Old Guard	Ted Krein	Shielding the Storage Precipitation	University of Idaho

(*Continued on page 852*)

REGION VII, PACIFIC SOUTHWEST, STANFORD UNIVERSITY, STANFORD, CALIF., MAY 16–17, 1952

Attendance: 59 Papers Presented: 9

Prize	Recipient	Title of Paper	College
First	Robert W. Gaul	Electrical-Analog Solutions of Transient Heat-Flow Problems	University of Santa Clara
Second	Stanley Groner	Axial-Flow Pump Impellers	California Institute of Technology
Third	Robert Stanaway	Cavitation in Venturis	California Institute of Technology
Fourth	George W. Gurr	Nitromethane as a Fuel Additive	University of California
Old Guard	George W. Schatz	Structural Response to a Concentrated Load	University of Santa Clara

REGION VIII, NORTHERN TIER, UNIVERSITY OF ARKANSAS, FAYETTEVILLE, ARK., MAY 5–6, 1952

Attendance: 83 Papers Presented: 9

Prize	Recipient	Title of Paper	College
First	Ralph Turnquist	Utilization of Solar Energy	Kansas State College
Second	Cleve Stoskopf	A Front-End Suspension for Automobiles	Kansas State College
Third	Charles W. Stephens	Engineering as a General Education	University of Kansas
Fourth	Cletus Lorensen	Development of a Small-Package Water-Tube Boiler	University of Nebraska
Fifth	Paul F. Sprehe	Recent Developments in the Heat Pump	University of Oklahoma

REGION VIII, SOUTHERN TIER, UNIVERSITY OF TEXAS, AUSTIN, TEXAS, FEB. 29–MARCH 1, 1952

Attendance: 200 Papers Presented: 13

Prize	Recipient	Title of Paper	College
First	Charles W. Bevier	The Vortex Tube as a Refrigerating Device	Southern Methodist University
Second	Harold G. Jindrich	Symbolic Logic	University of Texas
Third	James J. Smetana	Gas Turbines in Automobiles	University of Texas
Fourth	Julius M. Germany	Underground Freight	Southern Methodist University
Old Guard	L. Glenn Rader, Jr.	Maximum Unit Extraction of Water Vapor and Liquid Hydrocarbons From Natural Gas	Texas A&M College

1953 ASME Mechanical Catalog and Directory

THE forty-second annual ASME Mechanical Catalog and Directory, 1953 edition, is currently being distributed to ASME members. To compile this book new each year requires months of work. Suppliers of mechanical equipment must be canvassed for descriptions of equipment, new and old. They are also approached for lists of products for the directory, new and old. Headings are under scrutiny at all times; and by suggestions from members of the Society and by developments in industry, revisions in phraseology are incorporated to make the volume more serviceable.

New freshly cast type is used each year to make for ease in reading. Proofs are carefully checked by many people to provide for accuracy.

In this way members are supplied each year with a new book with products, names, and addresses up to date.

According to the editors of the volume, it is the only book which covers the field of mechanical engineering so thoroughly.

A 20-page insert describing all ASME publications is included in this volume for the ready reference of ASME members. This insert describes all publications, periodicals, codes, and standards available through the publication sales department.

Internal-Combustion-Engine Industry Congress Plans Announced

Proceedings of First Congress Available

THE first International Internal-Combustion Engines Congress was held in Paris, France, May 7–15, 1951, on the initiative of the Syndicat français des Constructeurs de Moteurs à combustion interne. In many countries the groups interested in this industry welcomed the idea and an organizing committee was formed by representatives of the following countries: Belgium, Denmark, France, Germany, Great Britain, Holland, Italy, Sweden, and Switzerland. Among the other countries who participated were: Austria, India, Norway, Spain, and the United States.

More than 500 specialized engineers and authorities in the field, representing 16 nations, visited plants, yards, and laboratories in the Paris region and in the Provinces in the course of two study excursions, May 14 to 17. During the technical sessions they discussed some 90 papers, which were international in scope.

Proceedings Published

The findings of the Congress are recorded in two volumes of proceedings of more than 800 pages each. For all information concerning the publication and sale of the Proceedings of the First International Internal-Combustion-Engine Congress apply to S.E.D.O.M., 10, av. Hoche, Paris (8°), France.

As a result of the success of the first congress the Permanent Committee plans are presently under way for a partial Congress to be held in Milan, Italy, in April, 1953. The subject to be discussed will be "The Use of Heavy Liquid Fuels in High- and Medium-Power Diesel Engines."

Milan Congress Program

The working program established for the discussion of this subject has been divided into sessions on: Consumable materials and their treatment; Construction of engines for utilizing heavy fuels; and Results of utilization.

The official languages of the Congress are English and French. American participation for papers is urged and the personal attendance by American members during the sessions of the Congress is cordially invited.

Extensive Opportunities for Engineers in the Coal Industry

THE engineering research and development that have given this nation the world's most productive coal industry must be continued and intensified if fuel demand is to be satisfied in the future, a Member of Congress, who is also a coal operator, writes in the August issue of the *American Engineer*. The author of the article, "The Engineer—Key to Coal Progress," is Rep. A. B. Kelley, who for many years has been in the coal business.

Pointing out that coal will be required to assume more of the work now consigned to natural gas and oil as reserves of those fuels are depleted, Congressman Kelley cites estimates of an annual coal requirement of one-billion tons in this country by 1975. He explains how the bituminous-coal industry has mechanized its operations, declaring that "this amazingly efficient productive system has been wrought by the genius of engineering talent and put to practical use by farsighted management and a force of skilled technicians."

Further application of engineering research and development will be required to handle the flow of coal of "continuous mining machines," according to the Pennsylvania Congressman, who quotes sponsors' claim that the machines can conceivably raise productivity to about 14 times today's record output of seven tons per man-day. But this potential capacity is predicated on the solution of other problems by the engineering profession, Mr. Kelley notes, adding:

"Thus in creating a new mechanical monster that can revolutionize the world's foremost mining system, the engineer has concomitantly produced other technical complications which he alone can solve."

The article reviews how coal's quality has been improved through the development of "another symbol of engineering achievement," the preparation plant, where the product is cleaned and sized to consumer specifications. Through this process and consequent improvement in boiler equipment and firing techniques by combustion engineers, the article continues, efficiency of coal has increased to a point where, in the case of the electric-utilities industry, one pound goes as far in the generation of power as three pounds did 30 years ago.

There are "unlimited opportunities" for members of the engineering profession in the field of coal utilization, Mr. Kelley declares, particularly in the synthetic-fuels and coal-chemicals industries.

Technological Advancement Council Formed

FORMATION of The Council for Technological Advancement, "to program, pioneer, and promote ideas for a more dynamic American economy," was announced by William J. Kelly, Chicago industrialist and president of the Machinery and Allied Products Institute with which the new Council is affiliated.

The program of the Council will be under the guidance of a board of trustees of 38 industrial executives of companies particularly identified with technological advancement, with Mr. Kelly as chairman.

"We have long been conscious of a need to accelerate and expand the long-range MAPI program of fostering the conditions essential to technological advancement for peace and national defense," Mr. Kelly said. "We have also found that there is a vast potential of industrial leadership for study and action centers such as MAPI has used so effectively.

"The Council for Technological Advancement will multiply the effectiveness of the techniques pioneered by MAPI, and provide new and additional channels of expression for the leaders with alert minds in the capital-goods industries who see old ideas and new and stimulating relationships and who have the capacity and willingness to face problems with energy, freshness, and breadth of vision.

"Our primary objective will be to promote ideas for a more dynamic American economy—an economy in which maximum benefits will be derived from technological advancement."

General outlines of the Council have been extensively discussed at MAPI meetings during the past six months, according to Mr. Kelly. Decision as to specific projects to be undertaken will be made by the new board of trustees, but it has been agreed that the major fields in which the Council will be active are: Marketing of industrial equipment, both domestic and export; exchange and promotion of engineering ideas on plant modernization, alternative production methods, plant construction and location, and the like; equipment leasing and financing to facilitate acquisition of new facilities; advancement of thinking on and understanding of measures which may be taken by industry to alleviate the cycles of demand for capital goods; inter-industry and university collaboration on economic and industrial research; the relation of patents to technological advancement; economic measurement of the effects of changing value of the dollar on industry's equipment depreciation and replacement policies; more extensive education of industry on capital-goods economics; and an information program for industry and the public on technological trends and new techniques, products and industries.

The activities of the new Council will be closely integrated with MAPI. Headquarters will be in the Chicago offices of MAPI, and the staff will be headed by Alexander Konkle, MAPI vice-president and executive vice-chairman of the Council for Technological Advancement.

J. F. Cunningham Appointed Chairman of TV Committee

J. F. CUNNINGHAM, JR., Mem. ASME, has been appointed chairman of the Columbus Technical Council Television Committee for the 1952-1953 season. K. W. Stinson, professor of mechanical engineering at Ohio State University, is the ASME Columbus Section representative to the committee. The committee supervises the production of a television program, "Engineering Your Life," which appears each Sunday afternoon at 3:30 over WBNS-TV, Columbus. Now in its second year, this program features the activities and accomplishments of engineers in the many technical societies and portrays problems encountered daily by engineers in their profession. It has been received with enthusiasm as a public-interest program and is an effective medium for inducing qualified high-school students to consider engineering as a profession.

Mr. Cunningham served as chairman of the Columbus Section of ASME during 1951-1952, and as delegate to the Regional Delegates Conference, and is still a member of the Region V Committee on Student Branches. He also served as president of Columbus Section SAM during 1950-1951. A graduate of Dartmouth and Ohio State University, he began his professional career with the Lincoln Electric Company. He has since been a welding engineer for the Elliot Company, works manager of International Derrick and Equipment Company, and is presently field representative of the Spencer Turbine Company.

New Laboratory at Battelle

BATTELLE Institute, Columbus, Ohio, broke ground for a new million-dollar "special purpose" laboratory building. Construction was authorized by the National Production Authority because of the important defense research being conducted at Battelle.

Some 300 industrial firms, in addition to the Air Force, Army, Navy, and Atomic Energy Commission, are sponsoring important research studies at Battelle. Director Clyde Williams, Mem. ASME, estimates that in the space provided by the new building, Battelle will be in a position to conduct an additional $2 million worth of research for defense agencies and defense industry.

The new building will be of a special reinforced-concrete construction designed to minimize vibration. This special feature was incorporated in the design, because plans call for the building to be occupied by research personnel working in electronics and other fields of research where delicate measurements are essential. The four-story brick-and-concrete structure will provide 80,000 sq ft of work area in 187 unit laboratories.

Indicative of Battelle's rapid expansion are the increases in personnel and in dollar volume of research conducted. The rate of research contracted rose from $9 million at the end of 1951 to the present rate of $12 million a year. During the past year, the staff has increased from 1384 to 1900.

ASME Calendar of Coming Events

Oct. 30–31
ASME Fuels and AIME Coal Divisions Joint Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.
(Final date for submitting papers was June 1, 1952)

Nov. 30–Dec. 5
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers was July 1, 1952)

April 28–30, 1953
ASME Spring Meeting, Deshler-Wallick Hotel, Columbus, Ohio
(Final date for submitting papers—Dec. 1, 1952)

May 24–28, 1953
ASME Oil and Gas Power Division Conference, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—Jan. 1, 1953)

June 28–July 2, 1953
ASME Semi-Annual Meeting, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers—Feb. 1, 1953)

Sept. 21–25, 1953
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Chicago, Ill.
(Final date for submitting papers—May 1, 1953)

Sept. 28–30, 1953
ASME Petroleum Mechanical-Engineering Conference, Rice Hotel, Houston, Texas
(Final date for submitting papers—May 1, 1953)

Oct. 5–7, 1953
ASME Fall Meeting, Hotel Sheraton, Rochester, N. Y.
(Final date for submitting papers—July 1, 1953)

Nov. 29–Dec. 4, 1953
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1953)
(For Meetings of Other Societies see page 855)

More Power to America Award, New Prize Announced by EEI

A "More Power to America Award," for the electric-utility companies that do the most to foster industrial electrification during 1952, and in each succeeding year, has been announced by the Committee on Prize Awards of the Edison Electric Institute.

Sponsored by the General Electric Company, the new award is designed to "increase the productivity of American industry by encouraging creative, broad-scale industrial electrification activity among America's electric-utility operating companies, and to bring recognition to the companies and individuals making the greatest advancement in this field each year."

The first award will be made by EEI at its 19th annual sales conference in Chicago, Ill. April 1, 1953. All electric-utility operating companies are eligible.

More Power to America Awards will be conferred in duplicate: one in Division A, for those companies with 250,000 total meters or more; and one in Division B, for those with less than 250,000 total meters.

In each division, a plaque will be given to the company which has done the most to

further industrial electrification, and $250 to the responsible individual.

For further information inquiries should be addressed to Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y. To compete for the 1952 award, entries must be postmarked not later than midnight Feb. 2, 1953.

Education

Oak Ridge Courses Announced

A COURSE on advanced radioisotope techniques in biochemical research will be given by the Special Training Division of the Oak Ridge Institute of Nuclear Studies from Nov. 3-14, 1952.

The first week of the course will be devoted to techniques centering around the use of Carbon[14]. The second week will be concerned with the other major isotopes used in biochemical research. Applications must be filed by October 1.

The 30th, 31st, and 32nd basic courses in radioisotope techniques in research will be offered by the Oak Ridge Institute of Nuclear Studies on Jan. 5, Feb. 2, and March 2, 1953.

Application blanks and other information may be obtained from Ralph T. Overman, chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

Educational Opportunities for Engineers Announced

A FOUR-point program sponsored by The Western Society of Engineers; the American Society of Civil Engineers, Illinois Section; The American Society of Mechanical Engineers, Chicago Section; the American Institute of Electrical Engineers, Chicago Section; the American Institute of Mining and Metallurgical Engineers, Chicago Section; and the Illinois Engineering Council, has been announced.

Under a new program designed as a result of a survey of sixty industrial leaders in the Chicago area relative to the outstanding deficiencies of engineers in their employ, three general-interest courses and two professional refresher courses are being offered in the fall quarter of 1952. This program includes courses among those considered most important by the industrial leaders who responded to the survey conducted by the Western Society of Engineers. These courses are made possible by the co-operation of major industrial corporations in the Chicago area, the combined efforts of the engineering societies, and the universities in the area. The courses include the following: Human Relations in Management; Rapid Reading Course; Executive Training and Business Management for Engineers, and courses providing a preparation for the professional-engineer's examination. In addition to these special courses a list of additional extension courses of interest to engineers in the Chicago area is available on request from the Western Society of Engineers, 84 E. Randolph Street, Chicago, Ill.

Novel Visual Approach in Technical Education Used by Steel Founders

USING a brand-new visual approach to technical education, Steel Founders' Society of America is preparing to carry the story of steel castings to student groups in all leading engineering schools of the nation during the 1952-1953 college terms.

Recognizing the increasing emphasis being directed to engineering-materials studies, the society has developed 11 new portable display panels specially designed to convey basic information on steel castings to engineering student and faculty groups in their own classrooms and lecture halls.

Dramatizing the steel-castings theme by use of color, animation, and illumination, the 4 × 6-ft panels operate electrically, flashing a series of kodachrome picture combinations featuring significant steel-casting applications selected to meet exacting engineering and design requirements.

One large color inset, for instance, emphasizes important engineering characteristics, listing such proved advantages as uniformity of structure obtainable through the use of cast-steel parts, proper distribution of metal in the casting process, broad choice of mechanical properties, good machinability, dimensional stability, ease of welding, fatigue resistance, and over-all economy in production.

Other kodachrome insets highlight typically important industrial applications and serve to dramatize visually the over-all panel theme of steel-casting versatility: "Steel Castings—Basic to Industry—One Ounce to 400,000 Pounds."

NSF Announces Graduate Fellowships in Science for 1953-1954

THE Second Graduate Fellowship Program of the National Science Foundation, providing awards for study during the 1953-1954 academic year in the mathematical, physical, medical, biological, and engineering sciences, will get under way early in October. The new program will follow the basic pattern set in the first year of operation. During the current (1952-1953) academic year, nearly 600 NSF Fellows will receive advanced training in science under this program.

The majority of awards under the 1953-1954 program will be made to graduate students seeking master's or doctor's degrees in science, although a limited number of awards will be made to postdoctoral graduates.

Application forms for both predoctoral and postdoctoral graduate fellowships for the 1953-1954 academic year may be obtained after October 1, 1952, from the National Science Foundation, Washington 25, D. Completed applications must be returned to the Fellowship Office, National Research Council, by January 5, 1953. The special examination for predoctoral candidates will be given at various places throughout the United States on January 31, 1953.

Tool Engineering

A FOUR-year course in tool engineering will be offered by Toledo (Ohio) University this year. The curriculum, which was developed in co-operation with Toledo Chapter No. 9 of the American Society of Tool Engineers, is open to high-school graduates.

A certificate of associate in industrial science will be granted to those completing the course. Forty three of the 56 credit hours in the curriculum can be applied toward a degree in engineering.

The tool engineering curriculum at Toledo University is one of many being initiated in colleges and universities through the efforts of the National Education Committee and individual chapters of the ASTE to help alleviate the national shortage of trained production engineers.

The entire Toledo University program can be completed in four years of evening-session attendance and thus can be utilized by junior tool engineers already employed in some phase of tool engineering and who desire further basic grounding in their field of work.

Chemical Engineers Plan Study Courses

AN inexpensive but authoritative method of bringing to chemical engineers in industry the latest developments in their field is described in a recent report on advanced study courses on a local level, recently released by officers of the Charleston, W. Va., Section of the American Institute of Chemical Engineers. The report tells how the Charleston Section set up a series of lecture courses by chemical-engineering experts in distillation and heat transfer, during the fall of 1951 and the spring of 1952. The report, made by M. C. Throdahl, Monsanto Chemical Company, chairman; et al., tells how the local group, by charging $6 for eight lectures, was able to pay lecture fees and travel expenses of the visiting experts invited from all over the United States. The distillation lectures were attended by 148 engineers and the heat-transfer lectures attracted 119.

The lectures of the Charleston group were so successful that more than 50 advance enrollment fees had to be returned because of lack of seating space. Each lecturer was asked to provide a complete set of notes and appropriate problems. These were reproduced and distributed immediately prior to each lecture.

Other local section educational activities of the American Institute of Chemical Engineers include a "Teach the Teacher" program where the local section sponsors visits by chemical-engineering faculty members to study local chemical plants, and programs for counseling chemical-engineering students on the industrial nature of their future profession.

Meetings of Other Societies

Oct. 13–17
American Institute of Electrical Engineers, fall general meeting, Jung Hotel, New Orleans, La.

Oct. 16–17
Gray Iron Founders' Society, 24th annual meeting, Hotel Cleveland, Cleveland, Ohio

Oct. 18–24
Metal Show, 34th national metal congress and exposition, Convention Hall and various midtown hotels, Philadelphia, Pa.

Oct. 20–23
Society for Nondestructive Testing, 12th annual meeting, Hotel Sylvania, Philadelphia, Pa.

Oct. 20–24
National Safety Council, 40th national safety congress and exposition, Conrad Hilton Hotel, Chicago, Ill.

Oct. 22–24
Porcelain Enamel Institute, 21st annual meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

Oct. 29–31
American Institute of Electrical Engineers, 5th annual machine-tool conference, Hotel Ten Eyck, Albany, N. Y.

Oct. 29–31
American Society of Body Engineers, 7th annual convention, Rackham Memorial Building, Detroit, Mich.

Oct. 30–31
Pennsylvania Electric Association, Prime Mover Committee fall meeting, Hotel Roosevelt, Pittsburgh, Pa.

Nov. 10–13
American Petroleum Institute, 32nd annual meeting, Conrad Hilton Hotel and Palmer House, Chicago, Ill.

Nov. 12–15
The Society of Naval Architects and Marine Engineers, 60th annual meeting, Waldorf-Astoria Hotel, New York, N. Y.

Nov. 19
American Standards Association, 34th annual meeting, Waldorf-Astoria Hotel, New York, N. Y.
(*ASME Calendar of Coming Events see page 853*)

Coming Meetings

Industrial Noise Control

THE president, Paul Washburn, of the National Noise Abatement Council, announced that the third annual Noise Abatement Symposium will be held Oct. 10 at the Armour Research Foundation of the Illinois Institute of Technology, Chicago, Ill.

Industrial noise, its effects and control, will be considered at the all-day meeting which will be attended by leading authorities on sound, industrial hygiene, safety, and acoustical engineering, industrial physicians, architects, city officials, health officers, and others interested in the growing noise problem.

Sponsors of the Symposium in addition to the Noise Abatement Council are Acoustical Society of America, Armour Research Foundation, American Industrial Hygiene Association, and the Acoustical Materials Association.

American Welding Society to Hold National Meeting at Philadelphia

THE American Welding Society's 33rd national fall meeting will feature an outstanding technical program of about 65 papers covering important welding techniques in the defense industries.

The meeting will be held at the Bellevue-Stratford Hotel, Philadelphia, Pa., during the week of Oct. 19, 1952. The American Welding Society will also participate as one of the sponsoring organizations in the National Metal Exposition and Congress to be held during the same week at Convention Hall, Philadelphia.

Special events during the meeting include the Adams Lecture and the presentation of prize awards on Oct. 20, and the popular President's Reception in the evening. The Educational Lecture Series covering the "Inert-Gas Metal-Arc-Welding Process" will start on Tuesday afternoon. Two interesting plant tours have been arranged: The Philadelphia Naval Shipyard or the Naval Air Materiel Center, as preferred; or the Steam Division of the Westinghouse Electric Corporation at Lester, Pa.

All tours will be restricted and visitors must comply with Navy regulations.

Time and Motion Study

THE sixteenth annual time and motion study and management clinic sponsored by the Industrial Management Society will be held on Nov. 5–7, 1952, at the Sheraton Hotel, Chicago, Ill. According to general chairman Ralph H. Landes, Western Electric Company, more than 2000 industrial engineers, works managers, plant superintendents, and supervisors are expected to attend the technical sessions.

Topflight industrial leaders from all over the United States will discuss the latest developments in the fields of time study, motion economy, job evaluation, methods, plant layout, materials handling, and human relations.

Feature of the event will be the annual methods-improvement competition, inaugurated last year to stimulate advances in industrial-engineering techniques and applications.

Inquiries may be addressed to the Industrial Management Society, 35 East Wacker Drive, Chicago 1, Ill.

Properties of Metallic Surfaces

A SYMPOSIUM on "Properties of Metallic Surfaces," organized by the Institute of Metals, will be held in the Lecture Theatre of the Royal Institution of Great Britain, London, W.1, on Nov. 19, 1952.

Apply for a program and Registration Form, to The Secretary, the Institute of Metals, 4 Grosvenor Gardens, London, S.W.1. The registration fee of 5s will entitle participants in the meeting to a set of advance copies of the papers, to enable them to take part in the discussion.

Among the papers contributed to the Symposium are the following:

Specialized Microscopical Techniques in Metallurgy, Radioisotopes in the Study of Metal Surface Reactions in Solutions, The Crystalline Character of Abraded Surfaces, Diffusion Coatings, The Nature and Properties of the Anodic Film on Aluminium and Its Alloys, Chemical Behavior as Influenced by Surface Condition, The Effect of Method of Preparation on the High-Frequency Surface Resistance of Metals, and many others of importance.

ASHVE to Hold Annual Meeting in Chicago

THE American Society of Heating and Ventilating Engineers will hold its 59th annual meeting in Chicago, Ill., Jan. 26–29, 1953, at the Conrad Hilton Hotel.

The eleventh International Heating, Ventilating, and Air-Conditioning Exposition will be held in conjunction with the meeting, at the International Amphitheatre on Chicago's south side. This will be the largest heating, ventilating, and air-conditioning exposition ever held, with over 300 exhibitors participating. The society will have space in the show and will feature several of its current research projects.

The society's Illinois Chapter will serve as hosts for the meeting. According to Prof. E. R. Queer, chairman of the program and papers committee, the technical sessions will present a large number of excellent engineering and research papers including several from the society's Research Laboratory and co-operating institutions.

Woman's Auxiliary Announces The Sylvia W. Farny Scholarship

THE Sylvia W. Farny scholarship fund was established by the Woman's Auxiliary to The American Society of Mechanical Engineers in the spring of 1952, in honor of Mrs. Farny, the first national president of the Auxiliary, whose leadership and enthusiasm contributed to the expansion of membership and formation of auxiliaries in many sections of the ASME throughout the country. Mrs. Farny's interest and activity in the Woman's Auxiliary continued until her sudden death which occurred soon after this educational fund was founded.

It is a fitting tribute to one who was a scholar and talented in arts and science to establish this fund for the purpose of assisting young engineering students in preparing themselves for their life's career. Funds applying to this scholarship are derived from an expanding membership, increased activity, and the formation of new auxiliary sections.

The first scholarship, a yearly award of $500, will be granted in the spring of 1953 to an American man or woman undergraduate student in mechanical engineering, enrolled in an accredited college or university in the United States, in which there is an ASME student branch, for use in his or her final year.

The award of this scholarship is based on scholastic achievement, financial need, and character. Because of the great number of accredited engineering colleges throughout the country, it has been decided to divide them into several groups in alphabetical order.

The colleges and universities which are to participate in the 1952-1953 award will be notified in November, and applications will be available at those institutions.

Literature

Journal of the Mechanics and Physics of Solids

THE first number of the *Journal of Mechanics and Physics of Solids*, an international research journal, will be issued in October, 1952.

It will contain original research papers, both theoretical and experimental, of a high standard. The following subjects to be included will give an indication of the scope of the journal: Creep; fatigue; elastic and plastic properties of engineering metals; stress analysis of structures and continua; significance of material tests; rationale of technological forming processes.

The journal will be edited by Prof. W. M. Baldwin, Jr., Case Institute of Technology, department of metallurgical engineering, Cleveland, Ohio, and Dr. Rodney Hill, department of theoretical mechanics, The University, Bristol, England.

Contents of the first number include the following: Plastic instability under plane stress, by H. W. Swift; on discontinuous plastic states, with special reference to localized necking in thin sheets, by R. Hill; calculations on the influence of friction and die geometry in sheet drawing, by A. P. Green and R. Hill; rheology of metals at elevated temperatures, by A. E. Johnson and N. E. Frost; the time laws of creep, by A. H. Cottrell; the yield phenomenon in polycrystalline mild steel, by W. M. Lomer; and book reviews.

The journal will be published quarterly.

Bolts

AN American Standard, Round Head Bolts, B18.5—1952, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, was recently published by ASME. This standard for round-head bolts (carriage, button head, step, and countersunk bolts) covers threads, thread lengths, length of bolt, length of tolerance, points, fillets, body diameter, square neck, heads, material, measurements, and defects. There also are 11 tables with diagrams. Copies of the standard may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Gaskets and Grooves

AN American Standard, Ring-Joint Gaskets and Grooves for Steel Pipe Flanges, B16.20—1952, cosponsored by Heating, Piping, and Air-Conditioning Contractors' National Association, Manufacturers' Standardization Society of the Valve and Fittings Industry, and The American Society of Mechanical Engineers, was recently published by ASME. This standard for ring-joint gaskets and grooves covers: types and sizes; material; dimensions, tolerances, and finish; identification numbers; and marking. There are two tables showing dimensions of ring-joint gaskets and grooves. Copies may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Lathes

AN American Standard, Accuracy of Engine and Toolroom Lathes, B5.16—1952, cosponsored by the National Machine Tool Builders' Association, Society of Automotive Engineers, Metal Cutting Tool Institute, and The American Society of Mechanical Engineers, was recently published by ASME. This standard, one of a series of standards for small tools and machine-tool elements, contains 25 tests recommending standards for determining the accuracy of engine and toolroom lathes. Copies may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Screw Threads

AN American Standard, Stub Acme Screw Threads, B1.8—1952, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, was recently published by ASME. This standard for stub acme screw threads covers: Specifications, classification and tolerances, thread designations, and formulas for determining diameters; several figures and 12 tables; and two appendixes. Copies may be purchased from ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $2.25 a copy.

Nuclear Data

ALREADY proved a valuable tool for nuclear physicists and engineers, radiochemists, biophysicists, and other workers in nuclear physics, the tables in *Nuclear Data* present a comprehensive collection of experimental values of half lives, radiation energies, relative isotopic abundances, nuclear moments, and cross sections. Decay schemes and level diagrams are provided wherever possible.

At present over 1000 new measurements of different nuclear properties are being reported each year in some 30 different journals and in the reports of dozens of different laboratories. Consequently, the reactor engineer and the industrial or medical user of radioactive tracer materials, as well as the nuclear physicist, need a listing of available data which can be kept up-to-date automatically.

In addition to presenting the tables, *Supplement* 3 contains a list of fission and spallation papers, a list of packing fraction differences, a list of journals surveyed in compiling the volume, references for the volume, and additions to references cited in Circular 499 and the two earlier supplements. *Nuclear Science Abstracts*, the semi-monthly abstract journal of the Atomic Energy Commission, will publish quarterly and annually the tabular summaries compiled by the NBS nuclear data group after July 1951.

Nuclear Data, Supplement 3 (January, 1951, to July, 1951) to National Bureau of Standards Circular 499, compiled by Katharine Way, Gladys Fuller, Marion Wood, Karin Thew, and Alice Jurgens, 66 pages, 98 tables. Order *Nuclear Data* for $4.25 a set from Government Printing Office, Washington 25, D. C. Each set includes Circular 499 (310 pages) and three supplements.

Western Resources

THE first issue of the Western Resources Handbook, produced by Stanford (Calif.) Research Institute, was made recently.

The new service was inaugurated with the dispatching of 150 data sheets to initial subcribers representing industry, government agencies, financial and business houses, libraries, and educational institutions. The circulation will be international.

The handbook is designed to serve as a basic reference source of data on all the economic and technical resources of the 11 Western states. Not confined to the natural resources, information is compiled on agricultural, manpower, industrial, and other resources necessary to the Western economy.

The first allotment of data sheets covers subjects ranging from water resources and commercial timber lands to production of electric energy and the canned fruit packed in the Western states for the past 30 years.

Beginning in September, new issues of 20 to 25 data sheets will be sent to subscribers periodically. Approximately 250 new sheets will be furnished annually.

A feature of the handbook is its graphic nature. Most production and consumption data are presented in tables by state for the West, together with the United States total.

Liberal use of maps has been made to present data on location of minerals and oil basins, location of industrial capacity, data on railroad lines, pipe lines, and similar factors.

Because of the public-service nature of the project, the book is not copyrighted and permission to quote and reprint is freely given by the Institute.

ASME Standards Workshop

Gas Industry Formulating Safety Code for Gas Piping

AT a three-day meeting of a newly organized subcommittee held in Chicago recently, work was begun on the formulation of a safety code covering the material, design, fabrication, installation, testing, and operation of gas pipe lines and related facilities.

Announcement was made in June by the American Gas Association and the American Standards Association that F. A. Hough, vice-president, Southern Counties Gas Company of California, Los Angeles, would head a new national committee concerned with gas transmission and distribution safety. The committee, known as Subcommittee No. 8 on Gas Transmission and Distribution Piping, of Sectional Committee on Code for Pressure Piping, B31, is sponsored by The American Society of Mechanical Engineers, as well as AGA and ASA. Mr. Hough serves as chairman because of his recent appointment

as representative on the Sectional Committee of the AGA's Natural Gas Department.

Subcommittee No. 8 will use as its starting point a forthcoming document known as Section 8, on Gas Transmission and Distribution Piping Systems, which is a consolidation of those parts of the Code for Pressure Piping B31 pertaining to gas piping. The subcommittee will revise and expand this section where necessary, and, upon its approval by ASA, will publish it as a separate document known as "Section 8, Code for Pressure Piping B31.1." It will also be included as the last section in future editions of the B31 Code. The Chicago meeting was devoted to full discussion of pipe-line problems and a careful review of existing requirements to determine to what extent the forthcoming Section 8 requires modification or expansion to reflect modern materials and technology.

AGA took a leading part in the preliminaries which preceded the start of the actual work on the revision of the code. In addition to naming Mr. Hough as its representative on the Sectional Committee B31, numerous conferences were held with key personnel of the industry. A preliminary meeting was held at the Natural Gas Department Spring Meeting at Los Angeles in May to organize a program before the meeting of the entire Subcommittee No. 8 in Chicago.

Safety Stressed

Although the gas industry has a long and enviable safety record, in view of recent technological developments it is believed that additional steps can be taken to assure safe construction and operation of its facilities. It is believed also that the experts comprising the committee will prepare a code having public safety as its major objective and that public confidence in the movement will be merited. Establishment of the code as an American Standard will assure its impartiality and objectivity.

Subcommittee No. 8 is composed of 52 representatives of gas-transmission and gas-distribution companies; pipe companies; valve and fitting companies; independent research groups; technical universities; consulting engineers; and government agencies. It will review specifications and codes already formulated or in the process of preparation by other agencies including private research groups, governmental agencies or AGA committees. Where present specifications appear inadequate, or where none exist, it will draw upon the resources of the many technical groups participating in this work.

Although preparations of American Standards sometimes take several years, Subcommittee No. 8 hopes to speed completion and publication of the Code on Gas Transmission and Distribution Piping through an accelerated program. Its officers and members plan to devote extra time to committee work. A full-time assistant will be employed, and frequent meetings will be called to review, consolidate and approve the material prepared by subgroups.

Members of Committee

In addition to Chairman Hough, officers of Subcommittee No. 8 are: Walter W. Davidson, Transcontinental Gas Pipe Line Corporation, Houston, vice-chairman, and chairman, Subgroup on Construction and Operating; C. F. DeMey, Columbia Gas System Service Corporation, New York, vice-chairman, and chairman, Subgroup on Pipe; C. T. Schweitzer, Southern California Gas Company, Los Angeles, secretary, and chairman pro tem, Subgroup on Design Stresses; B. T. Mast, Tennessee Gas Transmission Company, Houston, chairman, Subgroup on Compressor Stations; and Frank S. G. Williams, Taylor Forge and Pipe Works Company, New York, chairman of Subgroup on Fabricating Details and Mechanical Design. Mr. Williams also is chairman of Sectional Committee, Code for Pressure Piping B31, of which Subcommittee No. 8 is a part.

Junior Forum

Conducted by Joseph Schmerler[1]

Engineering-Manpower Shortage

How Schools and Industry May Alleviate the Situation

THE stereotyped picture of the engineer as a man married to a slide rule who spends most of his life humped over a drawing board is a misleading one. Engineers, today, are well-rounded persons who have developed the breadth of vision necessary in a global society. They are aware that men of industry have frequently outstripped the social scientists, the political scientists, and the economists. In the last 100 years, engineers not only have changed the physical appearance of the world, but have radically altered political, social, and economic relationships. The men who achieved these results had special talents. Presented with the findings of science, they had the perspicacity and initiative to adapt them in developing endless new products and services. America's men of industry possess the insight to understand human needs and the courage to invest industry's resources in making the goods to fulfill them.

In spite of the contributions engineers have made, there is an engineer shortage. Every day the need for engineers increases, while the number of young men who enter engineering schools is falling off.

Generally, the engineer is unable to exert wide personal influence. Doctors and lawyers, who are in constant touch with the public, have endless opportunities for exciting the popular imagination. Industry, knowing all the techniques of modern advertising and promotion, must do a real selling job to get more students to study engineering.

C. E. Davies, Secretary of ASME, reports that at various regional meetings of the Society, engineering college deans are expressing concern regarding the importance of students determining engineering careers before entering high school so that proper courses can be obtained. Mr. Davies quotes Dean Mohn of the University of Buffalo, Mem. ASME, as saying that the Parent-Teachers Association should be made aware of this situation so that they in turn can advise their local teachers and students.

To promote the early identification of potential scientists and engineers, the Third Edison Foundation Institute issued a report of its May 26-27, 1952, meeting on "How Can the Schools and Industry Work Together."

It was suggested by the Institute that schools should give consideration to:

1 Constantly emphasizing the critical importance of the development of correct work habits in students, and the appreciation and acceptance of the idea that long and hard work is the principal ingredient of success in anything—science and engineering being no exception.

2 Utilizing representatives of industry for supplementary instruction in appropriate phases of economics, engineering, and science.

3 Providing opportunities for joint discussion with representatives of industry on problems of mutual interest.

4 Supplementing customary instruction in science and mathematics by introducing practical problems suggested by industry.

The Institute urged that industry might give favorable consideration to:

1 Employing science and mathematics teachers and students during their summer vacations.

2 Encouraging science and mathematics teachers at the elementary, junior, and high-school levels to participate in local professional engineering and scientific activities.

3 Utilize sabbatical leaves for elementary and secondary-school educators who have made meritorious contributions to the teaching of science and mathematics.

4 Provide plant inspections for school officials, teachers, and students, as well as parents.

5 Explain to students the possibilities of careers in engineering and science.

6 Ascertain educators' reaction to industrial exhibits, literature, and visual aids. Support or continue to support such activities as science congresses, science fairs, Future Scientists of America, and junior academies of science.

7 Provide or continue to provide college scholarships and awards for high-school

[1] Design Engineer, Celanese Corporation of America, New York, N. Y. Jun. ASME.

graduates in need of financial aid who show promise of leadership in engineering and science.

In recommending such a course the Institute took into consideration the probability that the intellectual resources of a nation are finite. This contention has been expressed by S. C. Hollister, dean of engineering, Cornell University. Dean Hollister has stated, "If we assume that the intelligence level for the learned professions lies above an I.Q. somewhere between 115 and 120, we find that 120,000 males of a given age group, say, 18, are available for annual entry into the learned fields. This number of youth must supply medicine, science, engineering, law, theology, and the upper levels of the teaching profession.

The number must be discounted to allow for those who are lacking in ambition, emotional stability, perseverance, physical fitness, or economic means. It would appear that under normal circumstances less than 40,000 freshmen may be expected annually to enter the engineering schools. Thus the number of males of a given age group having an intelligence level suitable for the pursuit of engineering study is a fixed percentage of the age population, a percentage which we have reached in our current freshman enrollment of 38,000."

In light of the shortage of engineering talent and Dean Hollister's evaluation of the limited intellectual supply, industry and the schools must supply the logical reasons for demanding more students to seek careers in engineering.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York, 8 West 40th Street | Chicago, 84 East Randolph Street | Detroit, 100 Farnsworth Ave. | San Francisco, 57 Post Street

Men Available[1]

Mechanical Engineer, 29, married, 7 years' varied production experience including industrial engineering, quality and production control, line supervision, and plant management. Seeks production-management position in progressive medium-sized plant. Me-899.

Development and Design Engineer, 33, BS. 10 years' experience specialized instruments, controls, and light machinery. Capable of handling complete projects. Some construction and plant experience. Desires medium-sized aggressive company. Me-900.

Publicity-Mechanical Engineer, 33 years' experience as editor, writer, public relations, advertising, and market research executive promoting product acceptance and good will for heavy construction firm and steam-power equipment manufacturers. Me-901.

Mechanical Engineer, 32, married, veteran, BME, cum laude; MSME, Pi Tau Sigma, Tau Beta Pi; four years machine shop; 2½ years plant engineering and safety; 1½ years machine design. Speaks and writes German fluently; some French. Presently employed. Desires more responsible position, preferably Eastern U. S. Me-902.

Industrial Engineer, 29, strong engineering and administrative background in automotive and machine-tool industries. Six years' experience in estimating, pricing, methods, processing, tooling, and supervision. Desires management position. Me-903.

Mechanical Engineer, 33, registered. Broad metallurgical background. Experience in laboratory, foundry, weld fabrication and machine shop, ferrous and nonferrous metals. Desires production or development work in East. Me-904.

Technical Editor, BS (ME), MS Journalism. Formerly supervisor of technical publications for aircraft research and developing firm, technical editor and specification writer for large aircraft and missile manufacturer. Prefers New York City or vicinity. Me-905.

Engineer, 42, BSME, management experience, including plant operation, mechanical development, and quality control, for a large Detroit manufacturer of precision-engine parts; desires position affording opportunity for additional responsibility. Me-906.

Mechanical Engineer, 28, BME, four years' engineering variety-food manufacture: packaging, bakeshop, and plant equipment; design and maintenance. Three years machine shop and tool design. Employed as assistant plant engineer large commissary operation. Me-907.

Mechanical Engineer, 29, BS, MS, six years' varied experience in part-time free-lance design, industrial design, broad machine-shop background. Prefers machine development, medium-sized manufacturing plant. East. Me-908.

Production, Development Executive, 47, married, AB, BS, ChE, 24 years' diversified chemical-mechanical industrial experience, including vice-president production and research of two companies. Employed, seeking betterment. Prefers Calif. Me-909.

Manufacturing-Management Engineer, mechanical, 25 years in large and small companies; rotating electrical apparatus, domestic refrigerators, high-pressure gas equipment. Supplemental training in accounting and sales. Good manager and co-ordinator. Me-910.

Mechanical-Industrial Engineer, 26, BSIE, MSME, two years' diversified experience in general process-plant industrial engineering, application of machinery, technical correspondence, desires responsible position in related field. Prefers East. Me-911.

Positions Available

Consultant Industrial Engineer, 32–37, college degree, experience in several companies where a knowledge of one or more of the following phases of manufacturing has been acquired: production planning, methods, plant layout, materials handling, quality control production standards, timing. Some traveling. Up to $12,000, plus profit sharing. New York, N. Y. Y-7427.

Engineers. (*a*) Design engineer, BS in mechanical engineering, minimum of three to five years' experience in product design. Should be familiar with cast-iron boiler and radiator design. Will supervise design of new products and be responsible for improvements in the design of existing products. The present line consists of cast-iron and steel low-pressure heating boilers; cast-iron, hot-water-supply boilers; cast-iron radiation, unit heaters, and indirect water heaters designed for gas, oil, and coal burning. $7000. (*b*) Chief research engineer, experience demonstrating ability as an engineering administrator. Must be familiar with steam and water-heating product design. Knowledge of foundry practice desirable. Will be responsible for the efficient operation of the department and for the co-ordination of the work of the engineering department with the work of the other departments such as production and sales. $10,000 or more. New York metropolitan area. Y-7429.

Production Manager, tractor, construction, or farm-equipment manufacturing experience, to take charge of production scheduling, plan improvements, supervise subcontracting, inventory control, and parts service. $15,000. Calif. Y-7431.

Industrial Engineer, minimum of five or six years' experience in time-study and industrial-engineering practices pertaining to time study and methods. $5500–$6500. New York State. Y-7432.

Engineers. (*a*) Project engineer, mechanical graduate, at least eight years' design and development experience, including two years or more munitions, to take charge of design, development, and reports. $8000–$12,000. (*b*) Chief designer, mechanical graduate, at least ten years' mechanical or chemical-equipment experience, including two years or more munitions design, to supervise design and co-ordination of designers and draftsmen. $8000–$12,000. (*c*) Senior mechanical designer, graduate, at least eight years' experience on small devices, to prepare complex designs on munitions projects. $7200–$10,000. (*d*) Junior mechanical designer, graduate, two years' or more experience in internal ballistics, fuses, etc., to make studies and design products. $5000–$7200. Must be U. S. citizens. Md. Y-7442.

Industrial Engineer, mechanical or industrial-engineering degree, preferably under 40, to supervise a small staff of industrial engineers for malleable iron company, foundry work. Will supervise methods, rate setting, motion and time analysis, etc. Should have had at least five years' experience, preferably in foundry work. $8000–$9500. Midwest. Y-7466.

Design Engineer, experience in medium and heavy equipment such as machine tools, printing machinery, etc., to eventually assume complete charge of the design of molding presses and allied equipment for the graphic-arts industry. Must be able to interpret customer requirements and develop designs for production. Salary open. Upstate New York. Y-7479.

Plant Engineer, 35–45, mechanical graduate, at least five years' experience on shop-equipment maintenance, buildings, steam plant, filling and packaging, boxmaking, plastic molding for manufacturer of fine chemicals. $6500–$9000. N. J. Y-7486.

Mechanical Engineer, ten to 15 years' design experience, both as project and executive engineer. Experience must be heavy in design and development of small electromechanical devices such as electromagnets, transducers, microphones, relays, etc. Should be familiar with miniature electronic devices and amplifiers such as walkie-talkies, hearing aids, etc. Must be thoroughly familiar with modern methods in mass production, tooling problems, molding, die castings, finishes, etc., and price-conscious. Will take charge of a group of mechanical engineers and designers and have full responsibility for the mechanical part of all equipment and apparatus design. $8000. New York metropolitan area. Y-7491.

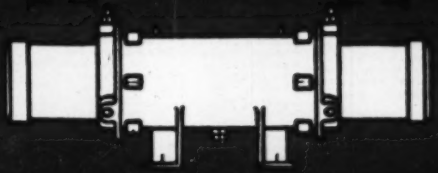
Mechanical or Civil Engineer, 35–50, degree, at least ten years' experience, to supervise and direct the design and installation of industrial wet-waste disposal systems and corrective systems for air pollution and dust control. Control the organization, planning, and scheduling of activities for efficient completion of work in accordance with requirements. Make preliminary engineering studies and prepare preliminary estimates for use as basis for executing decisions on wet-waste disposal or air-pollution problems. Follow up on field construction and installation phases until project is in efficient operation. Some traveling. Salary open. N. J. Y-7492.

Building Maintenance Engineer, mechanical

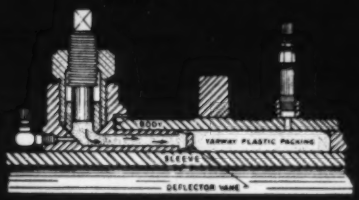
(*ASME News continued on page 860*)

[1] All men listed hold some form of ASME membership.

YOU NEED FEWER JOINTS



AND LESS MAINTENANCE



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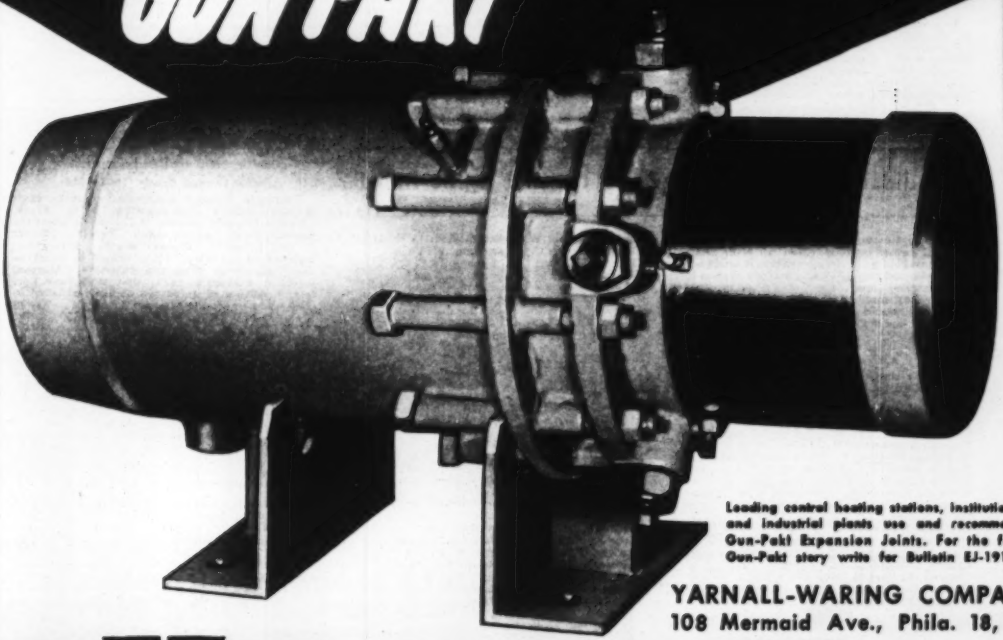

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YARWAY GUN-PAKT EXPANSION JOINT

graduate, institutional experience, to supervise engineering and maintenance staff. $6000–$7000. New York, N. Y. Y-7503.

Mechanical or Aeronautical Engineer, three years' aircraft design and manufacturing experience for aircraft-inspection work. $5060. Long Island, N. Y. Y-7506.

Design-Project Engineer, 26–36, mechanical-engineering degree and two to five years' experience in design and project work, to engage in design and development functions of engineering on present equipment and new equipment, including preparation of projects containing costs, etc., for management consideration; participation in direction of installation work. $4800–$6000. N. J. Y-7507.

Mechanical Engineer, graduate, young, three to four years' experience in air conditioning and refrigeration. Duties will involve editorial work on manuscripts submitted, some literary work, answering of technical inquiries, handling of correspondence of a technical nature. About $5500. New York, N. Y. Y-7516.

Plant Superintendent, at least ten years' copper stamping, spinning, polishing, and plating experience, charge of plant. $10,000–$12,000. Brooklyn, N. Y. Y-7533.

Design Engineer, 35–45, mechanical graduate, at least ten years' construction design and drafting experience, to supervise design, layout, and general drafting work for consulting firm, including plumbing, heating, air conditioning, water distribution, etc. $9000, plus bonus. New York, N. Y. Y-7534(a).

Mechanical Engineer, 30–35, experience on machine and tool design for small-product manufacturer of specialty items in paper and synthetic-materials fields. $6000–$7000. Miss. Y-7537.

Project Engineer, electrical or mechanical, six to ten years' design experience in electrical wiring of industrial equipment, control-panel design, and familiarity in instrumentation and electrical drives for special machinery. Company is engaged in design, development, and manufacture of various types of testing machines such as tensile testers, fatigue testing machines, gear testing machines, impact testing machines, etc. $6500. Conn. Y-7541.

Development Engineer, 40–45, mechanical graduate, to be responsible for the design of new machines and improvements to existing high-speed, automatic equipment for the production of paper and wood matches, small woodenware articles, conversion of paper products, and the production of molded pulp articles. Some traveling. Ohio. Y-7545.

Project Engineer, chemical or mechanical, 35–45, eight years' experience in design of chemical plants, the last two of which have been in project work. Knowledge of chemical plant construction and operation. Will do project work in conjunction with construction and operation of chemical plants doing Government work for a manufacturer of chemicals. Up to $8500. Company will pay placement fee. Idaho. T-9143.

Mechanical Engineer, 28–38, four years college, one year's experience designing heating, refrigeration, steam systems, conveyer installation, machine installation. Generally varied and interesting including new buildings, equipment, and maintenance. Supervision of work to some extent. $5000. Company will pay placement fee. Iowa. T-9160.

Plant Engineer, mechanical or electrical, 30–50, to supervise mechanical plant and equipment for mining operation including electrical stacker dredges, hydraulic and mechanical stripping-operations equipment, 10,000-kw steam-power plant, mechanical shops, trucks, and bulldozers for a mining company. Up to $12,000. Alaska. T-9172.

Plant Engineer, up to 55, three years' experience as plant or maintenance engineer in mining plant. Knowledge of surface mining and process-plant equipment. Duties include plant engineering and maintenance work for surface mining and processing operation of nonmetallic products, for a manufacturer of asbestos. $8500–$10,000. Company will negotiate placement fee. Calif. R-9127.

Project Engineer, mechanical or electrical, with two years experience in project work following through from beginning to completion. Will do project work on motion-picture and recording equipment and accessories. $6000–$7500. Company will pay placement fee. Ill. R-9142.

Project Engineer, over 35, mechanical, five years' experience in developing compressors for commercial use or pumps. Knowledge of ceramics and chemical industries helpful. Will calculate stresses and strains, bearing loads, materials, and development of special pumps, for a manufacturer of pumps. $8000–$9000. Company will pay placement fee. Ill. R-9175.

Sales Engineer, 30–40, mechanical or electrical, two years' experience in industrial sales. Knowledge of heating or ventilating helpful, to sell controls for heating, ventilating, and air-conditioning equipment. Preferably a Missouri resident. $6000–$7000. Company may negotiate placement fee. Some traveling; car required. Mo. R-9184.

Sales Manager, mechanical or electrical, 35 or over. Five years' experience in sale of instruments or process control equipment. Staff position as manager of industrial-controls division. $9000–$9600. Considerable traveling. Ill. R-9203.

Chief Engineer, 30–40, mechanical, five years' experience in designing chemical-type process equipment with broad background in selection of construction materials. Knowledge of stresses and pressurized equipment. Will assume responsibility for establishing mechanical design practices and supervising others. $8000–$10,000. Company will pay placement fee. Considerable traveling. Ill. R-9204.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Oct. 27, 1952, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Members, Associate, or Junior

ANBARI, MOHAMMED S., Marion, Ohio
BAGNELL, EDMUND J., South Charleston, W. Va.
BAKER, PAUL G., Cedar Grove, N. J.
BOECKMANN, ROBERT H., New York, N. Y.
BUNKER, ROBERT B., Albuquerque, N. Mex.
CASANOVA, JOHN V., Springdale, Conn.
CASE, EUGENE H., Waterloo, Iowa
CHAMBERS, ALBERT M., Jr., Palmyra, N. Y.
CHATTO, HARRY M., Cambridge, Mass.
CHIN, GAY, Elgin Air Force Base, Fla.
COKER, DONALD G., San Lorenzo, Calif.
COOPER, LESTER H., Alliance, Ohio
CORBETT, LAWRENCE W., Worcester, Mass. (Rt&T)
CRAMER, HUGH W., Seattle, Wash.
DAVIS, FRENCH C., Charleston, W. Va.
DAVIS, J. WESLEY, Jr., Greenville, S. C.
DEAN, NOBLE, Jr., Indianapolis, Ind.
DENNY, WILLIAM F., London, England
DUNN, ELMAN R., Cleveland, Ohio
DUTTON, WARREN A., Des Moines, Iowa
EBERHARDT, MARK E., Cincinnati, Ohio
FLEMING, ARTHUR T., Savannah, Ga.
FROMS, HOWELL E., Charleston, W. Va.
GALL, F. G., Charleston, W. Va.
GILLESPIE, JAMES R., Chicago, Ill.
GILLESPIE, WILLARD R., Detroit, Mich.
GLICKSTEIN, AARON, Kansas City, Mo.
GUPTA, CHHOTEY LAL, Kanpur, India
HACKNEY, LYLE R., Burbank, Calif.
HAGER, JOHN F., Boise, Idaho
HOEHN, RAYMOND J., Bellerose, N. Y.
HOPPE, WILFORD C., Milwaukee, Wis.
HOWE, WILBUR A., San Francisco, Calif.
HUHTALA, OLAVI A., Waterbury, Conn.
IREY, ROBERT C., Miami, Fla.
JOHNSON, CECIL M., Marshalltown, Iowa
JONES, JOHN F., Chattanooga, Tenn.
KAESSEN, DONALD A., Ashland, Ohio
KAO, YU-SUW, Taipei, Formosa, China
KIMMEL, FRED N., Webster, N. Y.
KROMAYER, PETER H., Bethlehem, Pa.
LEE, WILFRED J., East Syracuse, N. Y.
LEEMAN, WALTER H., Jeannette, Pa.
LOESCH, MURRAY, Brooklyn, N. Y.
LONG, THOMAS P., Jr., Bethlehem, Pa.
MACE, CYRIL W., Christchurch, New Zealand
MARGISON, ARTHUR D., Toronto, Ont., Can.
MCCUDE, RALPH M., Pittsburgh, Pa.
MCLEAN, ROBERT N., Jr., San Francisco, Calif.
MILLER, JOHN P., Olean, N. Y.
MOORE, WILLIAM N., Savannah, Ga.
MOORHEAD, OREN M., Massillon, Ohio
NAGPAUL, J. C., Allahabad, India
NELSON, HARLAN W., Columbus, Ohio
OLSZEKO, RAYMOND S., Detroit, Mich.
OLIVER, JOHN, Charleston, W. Va.
PE, MAUNG HLA, New York, N. Y.
PERKINS, LESTER B., Chicago, Ill.
POTTER, DONALD A., Indianapolis, Ind.
RAMACHANDRAN, SRINIVASA, Madras, South India
RAY, MILLARD L., Houston, Texas
RUPINSKI, WALDEMAR, Chattanooga, Tenn. (Rt&T)
SCHNEIDER, CARL D., Laurel, Miss.
SEPPA, WILLIAM O., New York, N. Y.
SEWARD, GEORGE A., Hinsdale, Ill.
SIEKMANN, H. JACK, Detroit, Mich.
SIMON, JAMES P., Lynn, Mass.
STANIUS, GODFREY, Crete, Ill.
STATON, WILLIAM J., Mission, Kan.
STEPP, ERMEL G., Charleston, W. Va.
STOHLMAN, DONALD G., Louisville, Ky.
STUCKENS, LEO J., Williamstown, Mass.
THURTZ, JULIUS J., Erie, Pa.
TYRRELL, MORRIS L., Narrows, Va.
VILLE, GEORGES, Paris, France
VISCO, AMERIGO R., New York, N. Y.
WARREN, WILLIAM J., Los Angeles, Calif.
WARRIS, MOHAMMED Y., Marion, Ohio
WHIPPO, HARRISON M., Jr., Boulder, Colo.
WHITAKER, WILLIAM C., Richmond, Va.
WILLEY, MARNEY B., Harvey, La.
WILSON, JOHN M., Cincinnati, Ohio
WOLFE, HAROLD K., Seattle, Wash.
WYNGARDEN, RAYMOND D., Houston, Texas
YATES, HENRY G., Northumberland, England

CHANGE IN GRADING

Transfers to Member and Associate

ANDERSON, NILS, Jr., Southport, Conn.
BERCHTOLD, MAX, Paoli, Pa.
BERG-JOHNSEN, JORN, Jr., Pine Orchard, Conn.
BUTTERFIELD, MAX A., Minneapolis, Minn.
CRAFTON, PAUL A., Washington, D. C.
DERRICKSON, GEORGE W., Jeannette, Pa.
DRECHSLER, FRANK S., Newark, Del.
HARTIG, ALBERT L., Jr., Fairport, N. Y.
HUBBARD, ROBERT A., Whittier, Calif.
KELLWAY, BRYAN J., Melbourne, Australia
LONGMUIR, GEORGE M., Oakridge, Tenn.
MAISSIAN, EDWARD D., Philadelphia, Pa.
MARVIN, RICHARD H., Abington, Pa.
MERCIER, JEFFRE P., New Orleans, La.
ORVIS, WARD C., Los Angeles, Calif.
PLUM, CHARLES R., Cincinnati, Ohio
SERRELL, JOHN J., Strafford, Pa.
WILSON, JOHN F., Dallas, Texas
ZOLLI, BASIL V., Los Angeles, Calif.

Transfer from Student Member to Junior 90

Obituaries

Julius Gordon Bently (1895–1952)

JULIUS G. BENTLY, mechanical engineer, engineering section, Headquarters Fifth Army, Chicago, Ill., died June 29, 1952. Born, Colorado Springs, Colo., Oct. 31, 1895. Parents, Chester P. and Ellen M. (Gudge) Bently. Education, high-school graduate; Hays School of Combustion; Alexander Hamilton Institute. Married Golda F. Pettengill, 1921; daughter, Faye Lorraine. Author of numerous papers published in coal trade papers. Jun. ASME, 1924; Assoc. Mem. ASME, 1925; Mem. ASME, 1935.

Walter Edward Blank (1886–1952)

WALTER E. BLANK, supervisor, Tool Division, National Cash Register Co., Dayton, Ohio, died May 7, 1952. Born, Dayton, April 2, 1886. Parents, John H. and Katherine Blank. Education, public schools in Dayton. Married Clara H. Kroger, 1914. Mem. ASME, 1942. He served the Society as treasurer, vice-chairman, and secretary of the Dayton Section. Survived by wife.

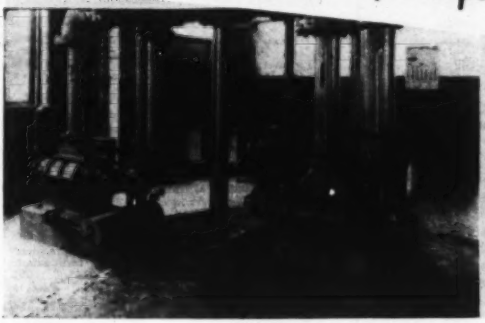
William Spencer Campbell (1892–1951)

WILLIAM S. CAMPBELL, designer and sole owner of Dugan and Campbell, Akron, Ohio, died Nov. 21, 1951. Born, Chicago, Ill., Feb. 21, 1892. Education, Windermere School, 1895–1903; Reading University, 1903–1907, both in England. Assoc. ASME, 1947. Held U. S. Patent covering a process for use in making tire molds.

(*ASME News: continued on page 862*)

MEASURE THESE VALUES WHEN YOU BUY METERS

Accuracy·Capacity·Compactness



Part of an installation of nine R-C Positive Displacement Meters in large chemical plant. Capacities from 3,000 cfh to 130,000 cfh.

Industrial buyers rate R-C Positive Displacement Meters "tops" in these basic essentials.

Accuracy—Not affected by pressure, wide variations in loads or other variables. Simple design, with no vanes, valves or small parts, results in maintained accuracy over long years of operation.

Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, to meet practically any industrial metering requirements. Ample ability to absorb overloads.

Compactness—foot for foot of capacity, R-C Meters are the smallest made for industrial use. Can be "tucked away" in relatively small space without loss of valuable production area.

These values have long been proved by large and small industrial plants and public utilities. More R-C Meters are used by gas producing plants, for their own manufacturing and for commercial customers, than any other make. For details on sizes and construction, ask for Bulletin 40-B-14.

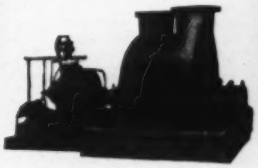
ROOTS-CONNERSVILLE BLOWER CORPORATION
524 Michigan Avenue, Connersville, Indiana

Three large R-C Meters in public utility plant. Unit in foreground has capacity of 1,000,000 cfh.

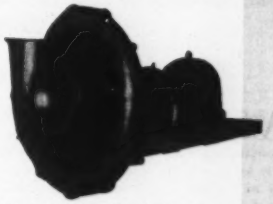
Reg. U.S. Pat. Office

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC

THE *DUAL-ABILITY* LINE OF MODERN EQUIPMENT TO HANDLE GAS AND AIR

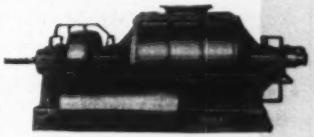


Multi-Stage Centrifugal Exhausters

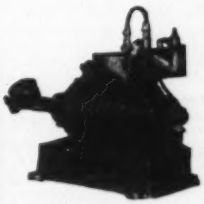


Single-Stage Centrifugal Blowers

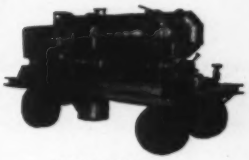
Rotary Positive Blowers



Rotary Positive Gas Pumps



Positive Displacement Meters



Inert Gas Generators

Edmund Joseph Daly (1870–1952)

EDMUND J. DALY, president, M. J. Daly and Sons, Inc., Waterbury, Conn., died June 26, 1952. Born Baltic, Conn., Dec. 22, 1870. Education, high-school graduate. Mem. ASME, 1926.

John E. Danielsen (1881–1952)

JOHN E. DANIELSEN, consulting engineer, Webster Groves, Mo., died April 13, 1952. Born, Stavanger, Norway, Oct. 28, 1881. Parents, Daniel A. and Elise C. Elmberg. Education, attended universities of Dresden and Riga, 1901–1908; ME, 1908. Naturalized U. S. citizen, St. Louis, Mo., 1927. Married Gertrude Grass, 1910; daughters, Ruth, Barbara. Mem. ASME, 1925. Survived by wife and family.

Charles Baker Davis (1875–1952)

CHARLES B. DAVIS, retired owner, C. B. Davis Engineering Co., Birmingham, Ala., died March 3, 1952, at his home in Bradentown, Fla. Born, Ann Arbor, Mich., June 16, 1875. Parents, Joseph B. and Mary (Hubbard) Davis. Education, BSCE, University of Michigan, 1901. Married Mabel J. Galbraith, 1902. Mem. ASME, 1915; charter member, Birmingham Section; chairman, 1928–1929. Survived by wife.

George Maslin Davis (1907–1952)

G. MASLIN DAVIS, refrigeration engineer, Engineering Service Division, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del., was killed in an automobile accident on June 10, 1952. Born, Winston-Salem, N. C., July 7, 1907. Parents, G. Maslin and Kelley (Rainey) Davis. Education, BS(ME), Virginia Polytechnic Institute, 1928; ME, 1929. Married Sue G. Guthrie, 1930; children, William M., James W., Elizabeth Ann. Jun. ASME, 1929; Mem. ASME, 1951.

William H. Elsner (1881–1952)

WILLIAM H. ELSNER, mechanical engineer, Great Northern Railroad, St. Paul, Minn., died in February, 1952. Born, St. Paul, Jan. 31, 1881. Education, attended Mechanics Arts High School; private instruction in special subjects. Jun. ASME, 1920; Assoc-Mem. ASME 1920; Mem. ASME, 1935. Survived by wife, Alma.

Alfred Edmond Forstall (1864–1952)

ALFRED E. FORSTALL, consulting engineer, New York, N. Y., died July 2, 1952, at his home in Montclair, N. J. Born, New Orleans, La., May 23, 1864. Parents, Theobald and Annie (Walton) Forstall. Education, ME, Lehigh University, 1883. Married Alice N. Dunn, 1892 (deceased). Author of many technical papers. Mem. ASME, 1899. Survived by three sons, Theobald, Monrovia, Calif.; Stuart, Montclair, N. J.; and Walter C., Amsterdam, N. Y.

Karl William Gass (1888–1952)

KARL W. GASS, vice-president, Amsler Morton Corp., Pittsburgh, Pa., died July 2, 1952. Born, Pittsburgh, Pa., Sept. 3, 1888. Education, ME, Cornell University, 1912. Mem. ASME, 1948.

Frank Bellchambers Hays (1899–1952)

FRANK B. HAYS, whose death was recently reported to the Society, was Commander, U. S. Navy; Deputy Head, Bureau of Ships, Navy Department, Washington, D. C. Born, Angels Camp, Calif., April 22, 1899. Education, gas-engine course, ICS, 1922; BME, Stanford University, 1925; MS(ME), University of California, 1940. Mem. ASME, 1946. Survived by wife.

Paul Frank Helm (1886–1951)

PAUL F. HELM, assistant to vice-president, charge of operation-engineering, Indianapolis (Ind.) Power & Light Co., died Dec. 3, 1951. Born, Murdock, Ill., Oct. 22, 1886. Parents, Robert F. and Martha E. Helm. Education, 3 years, Purdue University. Mem. ASME, 1938. Survived by wife, Eva, to whom he was married in 1920.

Lewis Abner Howland (1874–1952)

LEWIS A. HOWLAND, retired general superintendent, Queens Borough Gas & Electric Co., died June 12, 1952. Born, Oxford, Mass., Jan. 29, 1874. Education, BS(EE), Polytechnic Institute, Worcester, Mass., 1894. Mem. ASME, 1910. Survived by wife, Florence H.

Henry Edward Jacoby (1881–1952)

HENRY E. JACOBY, who was widely known in the chemical-machinery field, died July 13, 1952, in Yonkers, N. Y. Born, New York, N. Y., March 17, 1881. Parents, John H. and Frances Jacoby. Education, BS, The College of the City of New York, 1900; ME, Columbia University, 1903. Married Edith A. Chambers, 1907. Mem. ASME, 1916. Survived by wife; a daughter, Mrs. George S. Tarbox; and a sister, Mrs. Richard Foster.

Frank Raymond Laney (1883–1952)

FRANK R. LANEY, whose death was recently reported to the Society, was director of the J. M. Wright Technical School, Stamford, Conn. Born, Providence, R. I., Jan. 28, 1883. Parents, James H. and Sarah A. Laney. Education, graduate, Rhode Island School of Design, 1905. Assoc-Mem. ASME, 1918; Mem. ASME, 1928.

Charles Craig Phelps (1881–1952)

CHARLES C. PHELPS, whose death was recently reported to the Society, was the owner of Charles C. Phelps Co., Jersey City, N. J. Born, New York, N. Y., Dec., 12, 1881. Parents, John F. and Mary J. Phelps. Education, ME, Stevens Institute of Technology, 1908. Married Louise Noble, 1913; daughter, Beverly. Jun. ASME, 1909; Assoc-Mem. ASME, 1916; Mem. ASME, 1935. He was the author of several hundred articles on combustion engineering, compressed air practices, and oxyacetylene welding.

T. Kennard Thomson (1864–1952)

T. KENNARD THOMSON, consultant in construction of major buildings and bridges, engineer and inventor, died at his home in Yonkers, N. Y., July 1, 1952. Born, Buffalo, N. Y., April 24, 1864. Parents, William A. and Lavina D. (Newcomb) Thomson. Education, CE, University of Toronto, 1886; honorary DS, 1913. Married Mary J. Harvey, 1888. He held patents for underpinning buildings, tunnels, and lighthouses. He wrote chapters on caissons and foundations in books which are today regarded as standards, and numerous articles for engineering-society publications, technical press, and newspapers. Mem. ASME, 1907. Survived by wife; two daughters, Dr. Annis E. and Dr. Mary M.; three sons, Arthur K., Walter G., and Harvey S.; and a sister, Lulu T. Thomson.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult reverse side of card for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting your address, business connection, and Professional Divisions enrollment is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print — **Check mailing address**

Name ..... (Last, First, Middle)

Home address ..... (Street, City, Zone, State) ☐

Name of employer .....

Address of employer ..... (Street, City, Zone, State) ☐

Product or service of company .....

Title of position held .....

Nature of work done .....

Please register me in three Professional Divisions as follows:

1 .....

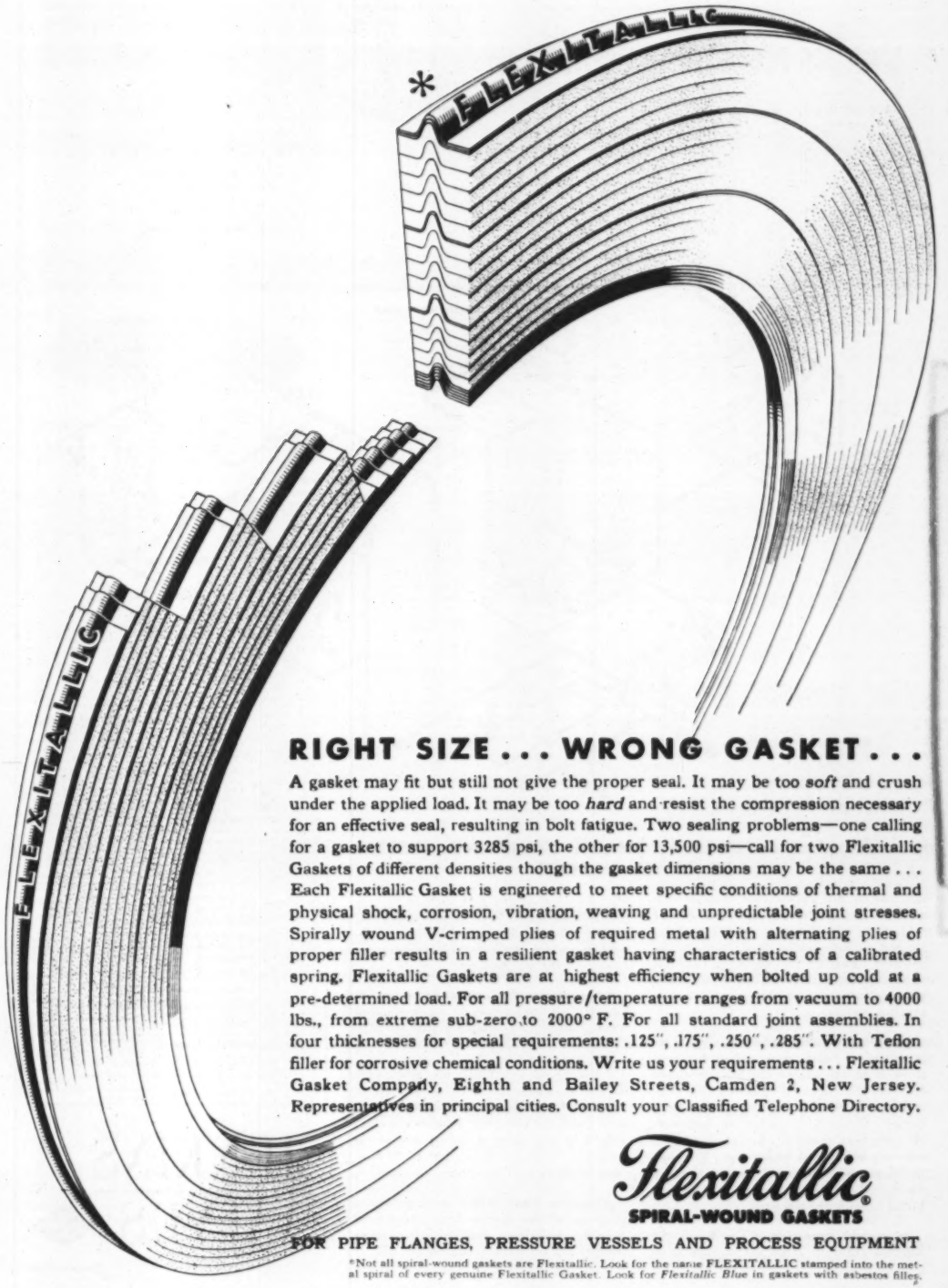
2 .....

3 .....

(Processing of address change requires four weeks)

I am a subscriber to (please check)

Transactions ☐ Journal of Applied Mechanics ☐ Applied Mechanics Reviews ☐



RIGHT SIZE . . . WRONG GASKET . . .

A gasket may fit but still not give the proper seal. It may be too *soft* and crush under the applied load. It may be too *hard* and resist the compression necessary for an effective seal, resulting in bolt fatigue. Two sealing problems—one calling for a gasket to support 3285 psi, the other for 13,500 psi—call for two Flexitallic Gaskets of different densities though the gasket dimensions may be the same . . . Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a pre-determined load. For all pressure/temperature ranges from vacuum to 4000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult your Classified Telephone Directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* in gaskets with asbestos filler.

JENKINS PRACTICAL PIPING LAYOUTS 63

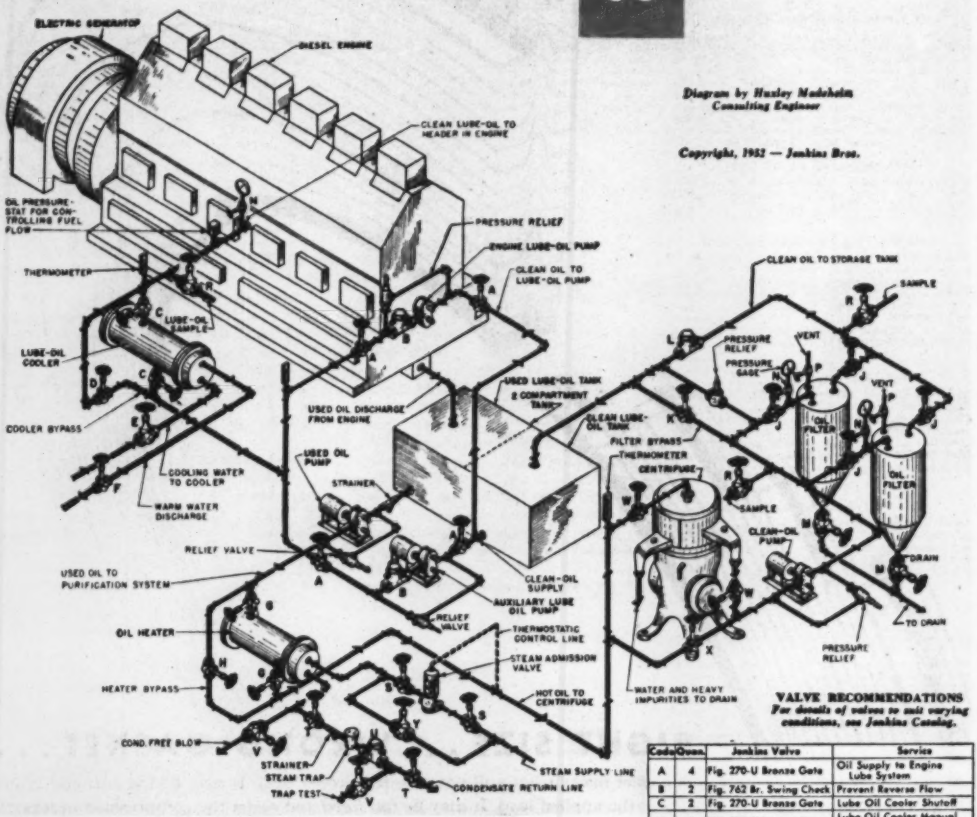


Diagram by Huxley Madeheim Consulting Engineer

Copyright, 1952 — Jenkins Bros.

VALVE RECOMMENDATIONS
For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	Jenkins Valve	Service
A	4	Fig. 270-U Bronze Gate	Oil Supply to Engine Lube System
B	2	Fig. 762 Br. Swing Check	Prevent Reverse Flow
C	2	Fig. 270-U Bronze Gate	Lube Oil Cooler Shutoff
D	1	Fig. 270-U Bronze Gate	Lube Oil Cooler Manual Bypass
E	1	Fig. 930 Bronze Globe	Cool Water Supply to Lube Oil Cooler
F	1	Fig. 270-U Bronze Gate	Water Discharge Shutoff
G	2	Fig. 270-U Bronze Gate	Oil Heater Shutoff
H	1	Fig. 270-U Bronze Gate	Oil Heater Manual Bypass
J	4	Fig. 270-U Bronze Gate	Oil Filter Shutoffs
K	1	Fig. 270-U Bronze Gate	Oil Filter Manual Bypass
L	1	Fig. 762 Br. Swing Check	Prevent Reverse Flow
M	2	Fig. 930 Bronze Globe	Filter Drains
N	3	Fig. 743-G Br. Needle	Pressure Gage Control
P	2	Fig. 930 Bronze Globe	Filter Air Vents
R	3	Fig. 930 Bronze Globe	Oil Sampling Take Offs
S	2	Fig. 270-U Bronze Gate	Steam Supply to Oil Heater
T	2	Fig. 270-U Bronze Gate	Condensate Shutoffs
U	1	Fig. 762 Br. Swing Check	Prevent Condensate Backflow
V	2	Fig. 930 Bronze Globe	Condensate Bypasses Free Blow Trap Test
W	2	Fig. 270-U Bronze Gate	Centrifugal Shutoff
X	1	Fig. 270-U Bronze Gate	Centrifugal Bypass
Y	1	Fig. 956 Bronze Globe	Bypass on Automatic Steam Valve

How to plan a LUBRICATION OIL PURIFYING SYSTEM FOR DIESEL ENGINES

Lubrication oil purification systems are used on practically all modern diesel engines to assure longer oil life and decreased engine maintenance. Purification, however, must be accomplished without removing beneficial oil additives which increase lubricant efficiency and preserve bearing surfaces.

The diagram above shows a typical lubrication oil purification system designed to meet diesel engine needs. Circulated oil from the engine is returned to a tank and part or all of it is pumped through a heater. Here, it is raised to optimum cleaning temperatures. A centrifuge then removes water and impurities. The partially cleaned oil next passes through filters, where light impurities and colloidal carbon are removed.

In normal operation of the diesel, the lube-oil enters a clean oil storage tank, after which it is pumped back to the engine through a cooler, generally a shell and tube heat exchanger with water as the coolant, which reduces oil temperature raised during purification.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run*. Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 63.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864
Jenkins Bros.

Keep Informed

ANNOUNCEMENTS OBTAINED MOSTLY FROM ADVERTISERS IN MECHANICAL ENGINEERING AND ASME MECHANICAL CATALOG

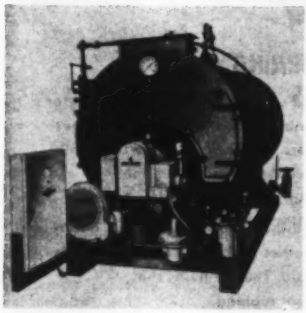
New Equipment *Business Notes* *Latest Catalogs*

Available literature or information may be secured by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING on a postcard.

New Equipment

Boiler-Burner Units

A complete new line of boiler-burner units is jointly announced by Kewanee-Ross Corporation of Kewanee, Ill., and Iron Fireman Manufacturing Company of Cleveland, Ohio. These completely integrated, compact units are the product of the combined combustion engineering skill and manufacturing experience of two of the best known companies in the heating and power equipment industry.



Each unit consists of an Iron Fireman packaged burner complete with all controls and a Kewanee Scotch boiler, completely assembled with its accessory equipment for oil, or oil and gas, or gas firing. The many desirable features and performance characteristics of the Iron Fireman combustion equipment and those of the popular Kewanee Scotch boiler are now available as completely integrated, carefully engineered combination units.

These boiler-burner units are available for high pressure steam and water in sizes ranging from 52 to 304 hp, 125 and 150 lbs. working pressure; also for low pressure 15 lbs. steam or 30 lbs. water, in sizes from 1,808,000 Btu to 8,400,000 Btu. They may be fired with No. 6 or lighter fuel oils, gas (either high pressure or as low as 2 oz), or a combination of both fuels. The line thus covers a wide variety of commercial and industrial applications for heating, power and process steam.

The boiler portion of the unit is completely assembled with all of its essential elements, tested, mounted on substantial steel skids and shipped direct from Kewanee to the job site. The boilers are constructed in strict accordance with The American Society of Mechanical Engineers' boiler construction code and are rated in accordance with the Steel Boiler Institute's rating code.

The burner portion of the unit, including all controls and forced draft air supply, is completely assembled, wired and factory tested. Matching connections are provided, so that when this packaged assembly, as shipped from Iron Fireman's Cleveland plant arrives on the job, it can be connected to the boiler in a very short time. All refractories are integrally mounted at the factory, thus reducing to an absolute minimum the amount of field work required in placing this combination boiler-burner unit into service.

The units are designed for forced draft operation, eliminating the necessity of a high stack. Provision need only be made for a small vent extending above the roof.

Complete specifications will soon be available. These will enable architects, engineers and contractors to select and specify the exact type and size of combination unit required for any application.

Owners of the units will enjoy nation-wide local service through the extensive facilities of the Kewanee and Iron Fireman field organizations.

Vibration Pickup

Development of a vibration pickup which can be used up to temperatures as high a 500 F has been announced by The MB Mfg. Co., Inc., New Haven, Conn.

Identified as the MB Type 122 Pickup, the insturment has no soldered joints or connections. All wiring, insulation, and materials are said to be of the type resistant to elevated temperatures.

Because of its precision construction, this insturment is claimed to have no practical lower limit on amplitude. Its sensitivity is stated as 21 mv per 0.001 in. double amplitude per 100 cps. The pickup is convertible to horizontal and vertical operation. According to the maker, electrical damping assures stability of calibration and permits the pickup to be used in severe tests. Usable frequency range is given as 5 to 2000 cps.

Wheel Truing Attachment

A continuous radius and tangent wheel truing attachment has been announced by Brown & Sharpe Mfg. Co., Providence, R. I. This attachment is designed to form, with one continuous movement of the diamond, accurate radii on grinding wheels with accurate tangents at either or both sides of the radii. Convex radii up to $^1/_2$ in. with tangents to $^5/_8$ in. in length at any angle, from 90 deg above horizontal to 20 deg below, can be formed; concave radii from $^1/_{32}$ to 1 in. (with diamond tool furnished) having tangents up to $^5/_8$ in. long at any angle, from 90 deg below horizontal to 20 deg above, can also be formed. The angles of the tangents are independent of each other (on concave shape included angle must be 90 deg or more).

The attachment is firmly clamped to the machine table by a single T-bolt. Accurate alignment is assured by two reversible tongues for T-slots $^1/_2$ or $^9/_{16}$ in. wide. These tongues are easily removed when the attachment is to be used on a magnetic chuck.

When truing a convex form, the angle of the tangent at the front of the wheel is controlled by the angular setting of the adjustable plate at the left side of the attachment body; the angle of the tangent at the back of the wheel is controlled by the setting of the plate at the right of the body. When truing a concave form the left-hand plate controls the rear tangent and the right-hand plate the front tangent. Verniers on the plates and matching scales on the attachment body facilitate the setting. Two clamp nuts on each plate maintain the angular setting. A gage provided, used in conjunction with a micrometer, permits setting the diamond to form an accurate radius on the grinding wheel.

After the attachment is properly set, the diamond is brought into contact with the grinding wheel and the wheel is accurately formed to the desired shape by turning the easily operated crank at the right.

Weights (approx.): net, 30 lb; shipping, 41 lb. Dimensions for shipment 16 × 8 × 10 in.

MINNEAPOLIS
Sept. 29, through Oct. 1.

MILWAUKEE
Oct. 7, through Oct. 10.

ST. LOUIS
Sept. 23, through Sept. 26.

BUFFALO
Oct. 29, through Oct. 31.

NEW HAVEN
Nov. 11, through Nov. 13.

BALTIMORE
Nov. 18, through Nov. 20.

NEWARK
Nov. 4, through Nov. 7.

CINCINNATI
Oct. 21, through Oct. 23.

WINSTON-SALEM
Dec. 9, through Dec. 11.

Coming to help you

solve problems in design and production!

"BRINGING the mountain to Mohamet might best describe Dow Corning Corp.'s traveling exhibit . . . Free standing panels . . . separate the exhibit into nine bays, each emphasizing a property of silicones and showing where that property brings a benefit to an actual end product or operating unit . . ."
INDUSTRIAL MARKETING (June 1952)

"NEXT TO THE GREATEST SHOW ON EARTH . . . We could go on . . . reciting the fantastic properties of Silicones, but just as breathtaking as the materials were the display techniques used to demonstrate them . . ."
CIRCUIT RIDER (Vol. 6, No. 2, published by Electrical Construction and Maintenance)

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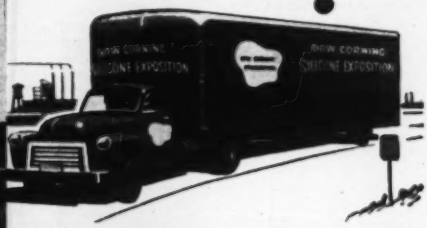
CHEMICAL WEEK (Jan. 26, 1952)

"IF YOU HAVEN'T already seen it, don't miss it when it comes around . . ."
POWER ENGINEERING (May 1952)



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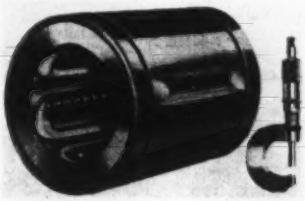
Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Linear Ball Bearing

To meet the demand from manufacturers of heavy-duty equipment, Thomson Industries, Inc., Manhasset, N. Y., announces the production of a new large-size linear ball bearing for use on 2½-in-diam. shafts. Heretofore these bearings, called ball bushings, have been available only in substantially smaller sizes which were not suitable for heavy load applications or where extreme rigidity requirements dictated the use of heavy supporting shafts.

The availability of this new large size brings the many advantages of this type of bearing to engineers and designers of machine tools, special machinery, and heavy equipment where linear motion is found. Their use on guide rods, for example, in place of plain sliding bearings which previously had to be used, will afford an extremely long life of exact precision alignment, as the near zero friction eliminates wear as well as the possibility of binding or chatter.



Their linear freedom is not dependent on the presence of an exposed oil film which, in the case of plain bearings, causes serious trouble when it becomes grit laden and gummy. Also, inaccuracies due to variations in oil film thickness and condition do not have to be considered.

The cost of a combination of ball bushings and round shafts is substantially less than accurately made flat beds or V-ways. This enables designers to make important economies as well as to improve operating characteristics by employing antifriction support for linear motions.

Packaged Steam Generator

The Titusville Type WTP Steam Generator, a completely shop-assembled water tube boiler, has been introduced by Titusville Iron Works Div. of Struthers Wells Corp., Titusville, Pa. Available in capacities from 7500 to 27,500 lb of steam per hr, the Type WTP can be fired with heavy oil; combination heavy oil and gas; light oil; combination light oil and gas; natural gas; manufactured gas; and coke-oven gas.

This unit is shipped as a complete package with all components installed, including pressure parts, refractories, insulation, casing, steam trimmings, feedwater regulator, forced-draft fan, burner, combustion controls, and safety flame-failure controls. Type WTP Steam Generators in capacities from 7500 to and including 15,000 lb of steam per hr are furnished with rotary cup type burners. Units of 15,000 lb per hr or larger are furnished with mechanical pressure steam-assisted oil burners.

With only simple foundations required and field installation work confined almost entirely to connections to oil, gas, water, electrical, and steam services—it is stressed

an ACCO product

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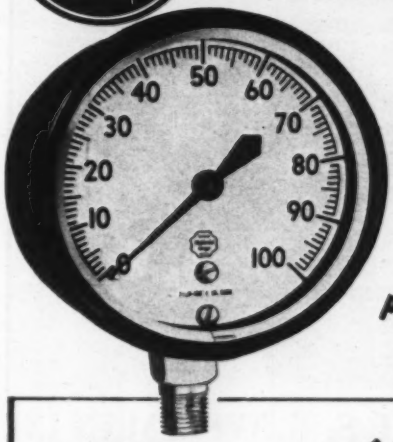

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The Helicoid Movement is a simple cam and roller design that has no teeth to wear out. Tested and proved in years of hard service. Helicoid Gages give long, trouble-free service with little maintenance.

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Disc Production *increased over* 100%

because THE S. K. WELLMAN CO. uses the PROFILOMETER

The S. K. Wellman Company of Cleveland, Ohio, world's largest manufacturer of all-metal clutch facings and brake linings, was experiencing trouble in the manufacture of a special clutch disc for use in a vital aircraft production unit.

Specifications for this special clutch disc called for its manufacture to be exceedingly thin and with a surface finish of no more than 32 microinches r.m.s.

When the thin clutch discs were first put into production, Wellman experienced warping, burning and glazing during grinding and lapping. Production was low and scrappage was excessive. Some method, Wellman decided, was needed to increase production yet maintain specified tolerances.

Then Wellman turned to the reliance of the Profilometer.

With the Profilometer, Wellman production men found they were grinding and lapping the thin clutch discs far too smoothly—from six to ten microinches—thus causing the disastrous warping and burning. It was also found with the Profilometer that grinding and lapping time of the discs could be cut to a minimum due to accurate on-the-job surface measurement. Surface finish was held to the specified 32 microinches. And most important of all—scrappage was almost entirely eliminated and production increased over 100%.

This is just another example of the ever increasing use of the Profilometer as an important *shop instrument.*

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins.

Profilometer is a registered trade name.

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Keep Informed

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

by the manufacturer that erection time and expense are substantially reduced over conventional field-assembled units or semi-packaged units. For simplicity in operation the Type WTP is equipped with either a fully or semiautomatic set of combustion controls. Efficiencies of 80% or better are attained when firing with oil and efficiencies approaching 80% are reached when fired with gas. The unit delivers steam of 99.5% or better.

The Titusville Type WTP Steam Generator is detailed in a new 6-page bulletin. No. B-3275.

Freight Truck

The Market Forge Co., Everett, Mass., is now supplying their electric Load-Mobile freight trucks with new reversible shelves. Designed to double the carrying area of this 2½-ton-capacity materials mover, the shelves are of sturdy all-steel construction.

Incorporating both a flat and a railed side, the shelves may be used with the flanged side down to handle bulky overhanging items or the flanged side up to carry smaller parts and parcels without danger of their falling off. More than one shelf may be used at the same time to further increase platform space. The Load-Mobile freight truck is also available with a rim-guard to hold goods in place on the main 14-sq ft freight deck.

Standard ¾-hp. series motor gives maximum speeds ranging from 3 to 5 mph, and provides adequate power to climb inclines of 5 to 10 deg, depending on the load. A new high efficiency 1-hp series motor is now available at low additional cost. Traveling speeds are increased 25–30% giving a maximum no-load performance of close to 6 mph. Both power units are interchangeable with those of the entire Market Forge 7-model Load-Mobile line.

In addition to carrying its own load, the truck is equipped to pull a variety of trailers. Weighing only 1450 lb including battery and having an over-all length of 92 in., the Load-Mobile freight truck offers a lot of transportation in compact form. The new shelving adds increased versatility.

For Consulting Engineers

Turn to Page 150

Keep Informed — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Air Control Valve

An electroaire explosionproof valve has been announced by The Bellows Co., Akron 9, Ohio. It is a modification of the original Bellows electroaire valve first introduced some five years ago. Bulletin No. AVX-310 describes the explosionproof valve in detail.

Automatic Ice Maker

A new Carrier Cub automatic ice maker, designed specifically to meet a large business demand, is announted by Carrier Corp., Syracuse, N. Y. It will make 200 lb of cubes or crushed ice daily.

Carrier officials said the new machine was built to specifications set up by hundreds of interviews with operators of hotels, restaurants, hospitals, taverns, supermarkets, meat markets, drug store fountains, and other locations where ice is employed.

A substantial number indicated a definite need for a machine similar to Carrier's revolutionary 450 lb a day ice maker—introduced several years ago, but in a smaller capacity and able to fit even more limited space requirements. The Carrier Cub, now available throughout the country at Carrier dealers, is the answer to their needs.

The new machine may be obtained in a combination model with a factory built-in crusher for production of either cubes or crushed ice at the turn of a knob. Models of this type are supplied with a divided bin, and the machine automatically deposits cubes in one section and crushed ice in the other Three grades of crushed ice from fine to coarse are available through a simple turn of another knob.

The machine produces only the amount of ice needed, shutting itself off when the bin is full. In addition to providing a completely sanitary supply of ice in the amount needed at the most convenient location for scooping it up, the new Carrier machine can save upwards of $1000 a year under the cost of ice brought in from outside, according to estimates. The machine makes 40 lb of either cubes or crushed ice for about six cents worth of electricity and water at normal rates, Carrier officials stated.

Carrier Cub ice makers are available in three sizes—with 100, 160, or 240-lb storage bins. With the 100 or 160-lb bin, the ice maker occupies a space only about two feet square, or about the same as the average candy or cigarette machine.

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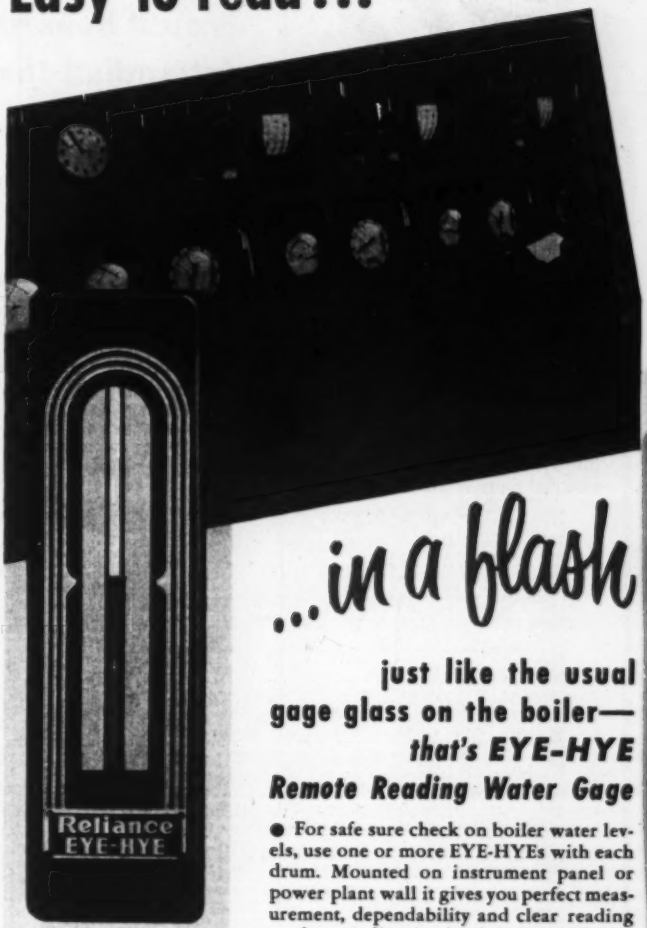

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Remote Reading Water Gage

● For safe sure check on boiler water levels, use one or more EYE-HYEs with each drum. Mounted on instrument panel or power plant wall it gives you perfect measurement, dependability and clear reading . . clear reading in simplest form, like the usual gage glass . . . clear reading in a column of brightly illuminated green fluid.

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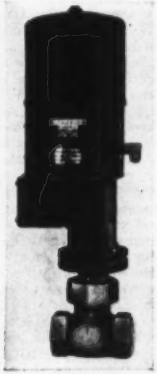
DON'T MISS THE POWER SHOW

ASME Auspices in conjunction with Annual Meeting

Keep Informed — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Motorized Valves

Mercoid motorized valves, Series G2-64 and G3-64 may be used with highly corrosive chemicals such as acid mine water, sulphuric acid and sulphurous acid, etc. The motorized valve is expressively suited for oxidizing applications and lends itself to innumerable applications for the prevention of product contamination or where straining of materials is a paramount importance, according to the maker Mercoid Corp., 4201 Belmont Ave., Chicago 41, Ill.



The Mercoid motorized valve is a two-wire motor-driven current failure type of valve, and operates on the hydraulic principle. The motor drives a hydraulic oil pump which actuates a spring-loaded piston, having ample power to move the valve stem uniformly on opening the valve. No gears are used in the mechanism which is oil immersed. After completing valve stem travel, an integral switch cuts off the pump motor. A small electromagnetic relief valve maintains the valve in the open position. Upon current failure the relief valve opens and the operator returns to its normal closed position by the spring-loaded piston.

Illuminated Scale Kit

A new Illuminated Calibrated Scale Kit for users of cathode-ray oscillographs who wish to bring their equipment up to date is announced by the Instrument Div., Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J.

The kit, designated as Type 2562, facilitates amplitude and time calibration for both visual and photographic applications. It is designed to fit any 5-in. cathode-ray oxcillograph with the standard Du Mont Type 2501 bezel and is especially useful under darkened room conditions or under a camera hood where a scale without illumination is difficult to discern.

The new kit consists of four incandescent bayonet-type lamps with sockets, a bezel, front and rear masks, a plastic rectangular-co-ordinate calibrated-scale, and a color filter. The lines on the clear plastic scale are engraved 10 × 10 to the in., with 1-in. vertical lines and 1/2-in. horizontal lines accentuated. The light from the lamps is diffused throughout the calibrated scale by means of four symmetrically arranged depressions on the scale.

The front and rear aluminum masks prevent measurements of a waveform at the

periphery of the cathode-ray tube where distortions inherent in all cathode-ray tubes tend to introduce errors. The inside diameter of these masks is 4 1/2 in.

The Type 2562 Kit also includes a dimmer control consisting of a 6-ohm potentiometer with a SPST switch, black knob, and 30 in. of No. 18 stranded wire. The dimmer control, which may be mounted on the front panel of the oscillograph, allows a continuous variation of illumination level of the calibrated scale. The switch allows control of power to the entire instrument.

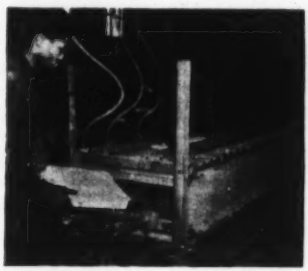
In addition, the Type 2562 comes complete with a filter suitable for the particular screen type employed. The use of a filter improves pattern contrast when there is an undesirably high level of ambient light upon the screen. When used with a screen material such as the Type P7, it separates the initial excitation from the persistence characteristic of the screen. Users of the Kit should specify the type of filter required.

Complete installation details are included in the Type 2562 Illuminated Calibrated Scale Kit. The normal complement of hand tools is all that is necessary to complete the job.

Core Drying

Precision plaster molds, used for aluminum casting, are being dried more evenly and precisely with far-infrared electric heat, according to the Scientific Cast Products Corp., Cleveland, Ohio.

Scientific's molds are now dried to the close tolerance of 0.001 in. per in. as compared with 0.002 in. variation under the previous batch-type gas-fired method. In the former batch oven the molds near the top, where hot air was forced in, dried faster than those at the bottom. Radiant heat now dries all molds evenly and consistently.



Details of the operation are as follows: A conveyer moves the molds through the oven at about 1 1/2 ipm maximum. The first 8 ft of the 12-ft oven are heated by 36 Chromalox radiant heaters with a total capacity of 39.6 kw. The longer "far-infrared" wave length is absorbed efficiently even by white materials, with negligible reflection—and rapid heating results in short conveyer travel. One size 12 × 22 × 1 1/2 in. dries in about 1 1/2 hr; the other, 12 × 22 × 2 1/2 in. dries in 2 hr.

In the present operation the production rate is about the same as before. However, the effective production has been raised by reducing from 25 to 10%, the rejected molds with further reduction expected as handling is standardized.

For more information write to Edwin L. Wiegand Co. 7646 Thomas Blvd., Pittsburgh 8, Pa.

Heli-Coil* Inserts present a new twist to screw threads.
They armor your tapped holes with precision-formed stainless steel wire, and put an end to stripping and corrosion.

This alone will be a decided advantage for your products in the competitive market. But there are still further basic design improvements and savings possible with *Heli-Coil* Inserts.

Smaller... fewer... or shorter cap screws can now provide the necessary holding power with *Heli-Coil* Inserts... even with short thread engagements. Cap screws can be repeatedly removed and replaced without damage to the threaded member when tapped threads are protected by *Heli-Coil* Inserts.

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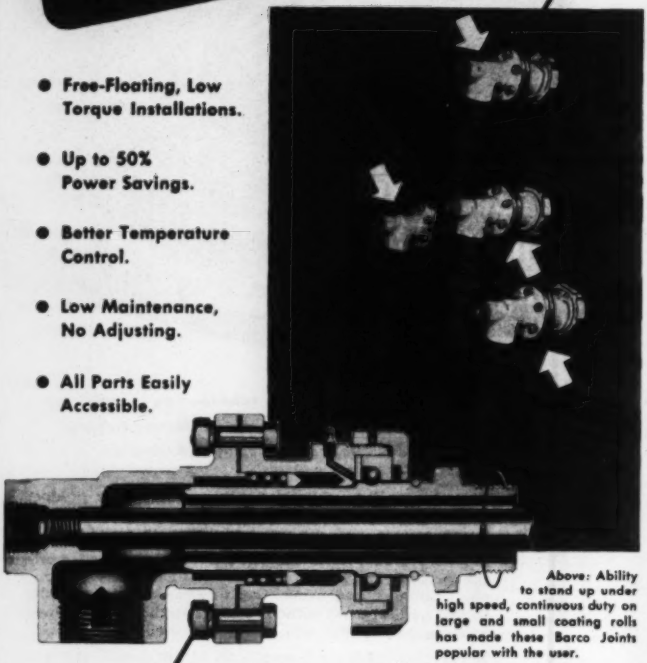

Above: Ability to stand up under high speed, continuous duty on large and small coating rolls has made these Barco Joints popular with the user.

• For complete information on this new Type IBR Revolving Joint, send for Bulletin 300.

LOW TORQUE (freedom from friction drag) is the key to Barco's *"free floating"* revolving joint installations. With this type of installation, Barco offers numerous advantages: power savings as high as 50% . . . very low maintenance requirements . . . quick, easy accessibility of parts . . . better temperature control . . . ability to withstand vibration and hard usage.

Take a look at Barco's new Type IBR Revolving Joint. Note the wide spacing between bearings which holds bearing loads and wear to a minimum. *Let us give you the complete story; ask for recommendations.* BARCO MANUFACTURING COMPANY, 1821L Winnemac Avenue, Chicago 40, Illinois. In Canada: The Holden Company, Limited.

BARCO REVOLVING JOINTS

The Only Truly Complete Line of Flexible, Swivel, Swing, and Revolving Joints

FREE ENTERPRISE — THE CORNERSTONE OF AMERICAN PROSPERITY

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Oil Mist Exhaust Systems

An article prepared by Trion, Inc., 1000 Island Ave., McKees Rocks, Pa., illustrates a few principles that should be considered in the design of a simple oil mist exhaust system.

The efficiency of any method of collecting the coolant oil mist will be judged by whether all visible mist is being removed. The problem of capturing the mist begins at the hood. The ductwork conveys the mist to the precipitator and the exhaust blower moves the air through the system. For a successful installation all these components must work at the same high efficiency as the electrostatic precipitator.

Standard electrostatic oil mist precipitators are available in capacities of 600, 1330, and 2000 cfm of air. For larger central systems, models of unlimited capacity are available on request from the factory. When water is used to dilute the oil coolant, a special collecting cell having isolated insulators is necessary and the factory should be consulted.

Each of the standard size oil mist precipitators consist of two separate sections. One section houses the electrostatic collecting cell. The other section contains the centrifugal exhaust fan. These sections may be furnished as a complete unit when the static loss through the system is $1^1/_2$ in. wg or less. When higher resistances must be overcome, a separate fan system should be designed using only the collecting cell section of the oil mist unit.

Each machine will usually require an exhaust capacity of 500 to 1000 cfm, depending on the type and design of hood and piping. In any case, exhaust capacities of less than 200 cfm per machine should not be attempted.

Choice of size and model precipitator depends upon: (1) The amount of air that must be drawn through an exhaust hood to catch all the mist in the vicinity of the hood, (2) the number of such hoods connected to one precipitator, (3) the static pressure drop (head loss) of the complete system.

The air volume to be handled by the exhaust hood may be determined by: (1) Measurements of actual air flow in exhaust hoods now operating under similar conditions with known high efficiencies, (2) direct experiment with full-scale models of hoods using an adjustable volume blower, (3) calculation by using any of numerous empirical formulas obtained from experiment.

It is a good idea to select a precipitator having a rated capacity at least 10% greater than the apparent requirements of the installation. The fan can always be made to handle less air on the job which will actually increase the efficiency of the precipitator. It may be found that in operating the systems, more air is sometimes desirable. If the precipitator is sized to its maximum capacity, this adjustment cannot be made.

In the design of a system, first decide upon a convenient location for the oil mist precipitator. This is usually the floor. However, in a machine shop, remember that floor space is at a premium. It is usually necessary, therefore, that the precipitator be mounted on a platform suspended on a wall or from the ceiling. The unit should be located as close as possible to the source of contamination. If one oil mist precipitator is to handle more than one machine, try to locate the precipitator so that the ducts from each machine will be about the same length. All ductwork should be round and the system should be electrically grounded.

Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Radiographic Inspection

A significant technological procedure of interest to users of power process accessories has just been added by Schutte and Koerting Co., Cornwells Heights, Bucks County, Pa., manufacturers of equipment for the power, process, and petroleum industries. It's an advanced method for quality control of steel equipment the company produces for use in high-pressure high-temperature power plants and in process plants.

The development centers around an x-ray machine, a radioactive metal, and a group of skilled technicians working under conditions similar to those in atomic laboratories.

Recently placed into operation, the new technique involves use of short-wave rays to "photograph" solid steel castings for the detection of hidden flaws or defects.

The technique, known as radiographic inspection, is based on the principle of x-ray photography. The short-wave rays are used to penetrate the object being inspected, to project a "picture" of the object's interior to a film. This film, when developed, will reveal irregularities in the metal not visible to the naked eye.

The equipment Schutte and Koerting employs to photograph castings are a 250,000-volt x-ray machine and a capsule of Cobalt 60, a metal made radioactive by exposure to the atomic pile at Oak Ridge, Tenn.

Both the x-ray machine and the Cobalt 60 produce the required short-wave rays. X-ray machine rays are used to penetrate castings up to 3 in. thick, while Cobalt 60 rays, which have power equivalent to slightly over one million volts, are used to penetrate castings up to 7 in. thick.

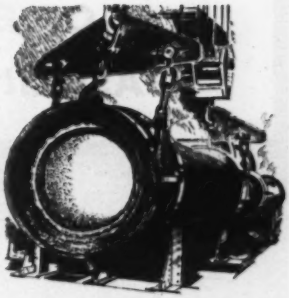
The Cobalt 60 inspection method is accomplished by placing a small cartridge of the radioactive element on the end of a long rod, holding it close to the surface of the casting, and using the rays produced to photograph through the casting.

Aluminum Filling Solder

A new use has been developed for Alcoa Aluminum as the principal ingredient in a filling solder. This new auto body solder called "Fil-Soder" takes 50% less heat than tin alloy solder and fills without fluxing or shrinking, according to the producer. It is suitable for all metal filling.

The manufacturer indicates that this new type of solder builds up fast, stays where it is put, and doesn't run or drip when working on an upright surface. No new tools or skills are required in its handling, and the solder will stand a 350 F infrared bake. It will take any finish, lacquer, or synthetic. Field tests in garages, body shops, and automotive refinishing shops indicate cost savings

Here's Another "Pipe Dream" That Came True in the BIRMINGHAM DISTRICT



In this central district of the Southeast, six huge pipe plants produce 60% of the Nation's cast iron pressure pipe. Typical of the district's great pipe plants that have advanced from small beginnings to the front rank of American industry is the—

AMERICAN CAST IRON PIPE COMPANY

Availability of pig iron primed the Company's establishment in 1905. Widespread building of waterworks and sewage disposal plants throughout the U. S. A. broadened its markets. Birmingham's strategic location as a distribution center and cooperative and efficient labor played a major role in its growth. These have been reinforced by a progressive management which pioneered the centrifugal "Mono-Cast" pipe spinning process and added recently extensive new facilities for making cast steel parts, tubes and industrial alloys. These find a market throughout this country and abroad. Many of "Acipco's" steel and alloy iron castings are finished for end use at its own plant. Because of limited open facilities in the Birmingham district for finished machining, a substantial tonnage of castings is shipped to machine shops in other States for final processing. Officers of "Acipco" and other Birmingham enterprises look forward to the day when many more well-equipped machine shops will locate in this area to fill a need and find opportunity for service and reward.

★ ★ ★ ★ ★ ★ ★

Members of the Birmingham Committee of 100 invite you to write for factual, specific information on what the Birmingham district has to offer you as a location for your branch plant, warehouse or sales office.

BIRMINGHAM COMMITTEE OF 100

1914 Sixth Ave., N., Birmingham, Ala.

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WELL ROUNDED PICTURE OF EFFICIENT GASOLINE STORAGE

Above: Three 10,000-bbl. Hortonspheroids designed for an operating pressure of 15 lbs. per sq. in. pressure at the Utah Oil Refining Company's refinery at Salt Lake City.

Every day—at hundreds of locations—Hortonspheroids are proving their ability to *more efficiently* store petroleum products ranging in volatility from motor gasoline to natural gasoline. Evaporation losses, caused by breathing, filling or boiling, are greatly reduced or eliminated all together. That's because the vents do not open and no vapor escapes as long as internal pressure does not exceed the setting of the pressure relief valve.

When planning installations for the storage of volatile liquids, consider the Hortonspheroid. Its spheroidal shape provides a substantial savings in material. The plates in the shell, including those in the bottom and the roof, are utilized more effectively than in cylindrical pressure tanks to resist liquid and gas pressure inside the vessel.

Plain Hortonspheroids are built in standard capacities from 2,000 to 40,000 bbls. for 2½ to 100 lbs. per sq. in. pressure. Noded Hortonspheroids are built in standard capacities from 20,000 to 120,000 bbls. for 2½ to 20 lbs. per sq. in. pressure.

Make use of our wide experience in building steel plate structures. Write our nearest office for quotations on any tanks or steel plate work you contemplate installing.

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Cleveland 15.....2240 Guildhall Building
Detroit 26.....1511 Lafayette Building
Houston 2.....2136 C & I Life Building
Los Angeles 17..1518 General Petroleum Building
New York 6.....3301—165 Broadway Building
Philadelphia 3.1618—1700 Walnut Street Building
San Francisco 4.....1356—200 Bush Street
Seattle 1.....1321 Henry Building
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NEW EQUIPMENT
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in both labor and material. It will be used for filling and soldering auto body surfaces, such as bumps and dents on fenders, panels, etc.

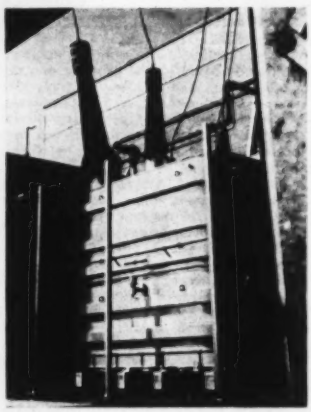
With its low melting point, Fil-Soder does not warp the metal, and it feathers to a smooth invisible edge. In addition to its value as a solder for automotive work, it also has possibilities as a suitable material for repairing ferrous and nonferrous castings.

Fil-Soder is available in $^3/_8$-in-round bars, 12 in. in length. Because of its lightweight four ounces of the new product will fill as much space as a pound of other solders. This is a product of Swiss Laboratory, Cleveland, Ohio.

100,000 KVA Power Transformers

For the unusual duty of withstanding within one hour as many as 15 deliberate short circuits as high as 1,100,000 kva, engineers of the General Electric Company's Power Transformer Dept. at Pittsfield, Mass., designed two of these 100,000-kva power transformers.

The special units are located at the company's new Switchgear Development Laboratory at Philadelphia, Pa. Ultimately, three of these 220-kv transformers will be used at the laboratory to "step-up" the voltage of 381-kv wye for three-phase tests of high-voltage outdoor circuit breakers and other switchgear.



To achieve the tremendous mechanical strength required in each transformer, the engineers used a high-voltage concentric layer winding which offers maximum resistance to bursting forces. A cylinder of steel, covered by insulating paper, was used to resist the compressive forces exerted on the low-voltage coils.

Because the windings will be subjected to severe impulse voltages when the opening of a transmission line is simulated at the laboratory, they have been designed with a basic impulse insulation level of 1550 kv.

The shielded, concentric layer winding inherently provides uniform distribution of impulse voltages, but because this transformer has five taps brought out through bushings, more than the usual protection is required. Electrostatic shields placed between each layer of the high-voltage winding produce the desired impulse characteristics.

Keep Informed

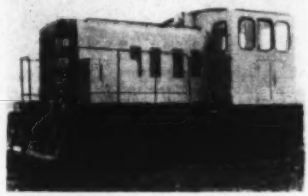
NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Diesel-Hydraulic Locomotive

Industrial locomotive Model SH 2190 Diesel-hydraulic locomotive, built by Baldwin-Lima-Hamilton Corp., Eddystone, Pa., is a 35-ton, 190-hp unit designed specifically for industrial plant switching service.

Powered by a 6-cyl, 4-cycle, supercharged Diesel engine, rated 225 hp at 1800 rpm, the locomotive has a starting tractive effort of 17,500 lb at 25% adhesion and 21,000 lb at 30%. Built for track gages from 30 to 66 in., over-all length is 17½ ft and wheelbase is 6½ ft.

Transmission equipment includes a Twin-Disc torque converter and clutch with two-speed transmission and an axle-hung reverse gear. Speeds are 10.6 and 28 mph. Underframe is all-welded steel slabs and plates with pedestal tie bars bolted beneath journal box openings. Journal bearings are roller type. The tension of the heavy-duty roller drive chain, connecting axle assemblies, is adjustable by means of journalbox shims.



The hydraulic torque converter, equipped with an over-center throw-out clutch, is mounted directly on the engine bell housing. Its infinitely variable torque multiplication feature provides smooth and gradual transmission of engine power to locomotive drive. It is impossible for torsional vibration or shock loads to be transmitted from engine to locomotive drive or vice versa, and its slipping characteristics eliminate engine stalling from overload.

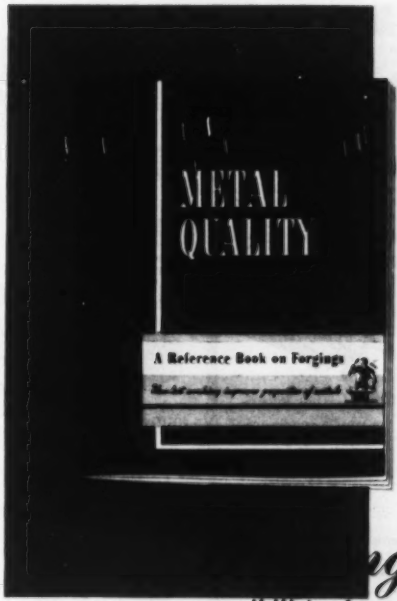
The two-speed transmission provides a 1:1 ratio in high speed and a 2.69:1 reduction in low gear. Gear-shift lever and throttle are interlocked to permit changing from one gear ratio to the other only at idle engine speed. The axle-hung power-operated reverse gear connects to the transmission output shaft by means of a sliding universal joint. Gears and shafts are of alloy steel mounted on heavy-duty roller bearings running in oil. Clutch and reverse transmission are air operated and electrically controlled.

Electrical equipment includes a battery and charging generator for engine starting, lighting, etc. The air brake system is Westinghouse straight air type with SA-2 self-lapping brake valve. Braking is provided only for the locomotive, but is available for train-line at extra cost.

Endless Belt Filter

Through the use of an endless belt the Delpark industrial endless belt filter permits the utilization of the same filtering media over and over. This filter, designed to serve individual machine tools or larger central coolant systems, can also be applied to numerous other industrial applications.

Through the use of various filtering media these units can be applied to practically every industrial filtering problem.



Engineering, production and economic advantages obtainable with forgings are presented in this Reference Book on Forgings. Write for a copy.

...ngs offer unlimited possibilities for solving Problem Parts Problems without creating other problems for other people. Check all the aspects of a problem part with the unrivaled economic and mechanical advantages of closed die forgings, and the closed die forging process for producing parts, and you will discover the possibilities for solving a problem part with closed die forgings. Then, consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.

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Please send 60-page booklet entitled "Metal Quality — How Hot Working Improves Properties of Metal", 1949 Edition.

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PUMPS

5000 PSI PUMPS

Rugged, high-pressure, high-volume pumps of hydraulically balanced axial piston design, for circuits developing up to 5000 psi. Constant or variable volume. Three sizes; volume capacities, 10, 20 and 35 gpm. Four types of volume control —handwheel, pressure-compensating, stem, or cylinder. Face, flange or foot mountings. Catalogs P-4-1, P-4-2, P-4-3

2500 PSI, 9 GPM PUMPS

Compact, economical constant-volume pumps of high efficiency. Hydraulically balanced axial-piston design. Three models offer capacities ranging to 3000 psi, 1800 rpm, 9.5 gpm. Catalog P-4-10

MOTORS

HIGH-TORQUE, FLUID MOTORS

Powerful, high-torque, axial piston type. Three sizes; torque ratings up to 5585 inch-pounds, or about 160 hp. Speeds to 2000 and 3000 rpm. Compact — largest size only about one foot in diameter. For circuits to 5000 psi. Catalog FM-3

COMPACT FLUID MOTORS

A fixed-stroke axial piston motor with high torque of 510 inch-pounds maximum — about 24 hp. Operates at maximum 3000 rpm; pressures to 2500 psi. Small, compact, efficient. Catalog FM-2

CONTROLS

¼" to 1½" DIRECTIONAL CONTROLS

Rugged, hydraulically balanced, 4-way valves for all requirements to 5000 psi. Seven standard spool combinations; threaded or subplate body types. Seven types of controls for valve operation — manual, hand lever, mechanical stem or cam, hydraulic pilot with or without throttle control, and single or double electric solenoid. Catalogs VD-3, VD-2, VD-4

POSITIVE PILOT OPERATED 4- WAY VALVE

A solenoid-controlled 4-Way Valve that eliminates spool-sticking during long, high-pressure holding cycles. System pressures shift valve spool; solenoid operates pilot valving only. Catalog VD-1-1

¾" to 2" PRESSURE CONTROLS

Denison relief, sequence and unloading valves provide closer control of system pressure with low differential between opening and closing pressures. Available in three pressure ranges for circuits developing up to 5000 psi. Choice of threaded body, subplate, or flange-type mountings. Catalog VR-2A

SURGE DAMPING CONTROL

Prevents destructive pressure shock in high-pressure hydraulic systems. Small, compact, light in weight . . . does not interfere with normal function of other hydraulic components. Adjusts automatically to any working pressures; cannot slow down cycling time. Industrial and Aircraft models — ¼" to 1" Catalog VS-1

PRESSURE REDUCING VALVES

For reduced pressure in secondary circuits without surge or fluctuating pressures caused by higher pressures of primary circuit. New Exclusive design features. For circuits developing up to 5000 psi — 20 gpm to 65 gpm. ¾", 1¼", and 1½" sizes. Threaded, flange or subplate mountings.

DENISON HydrOILics

for circuits developing up to

5000 psi

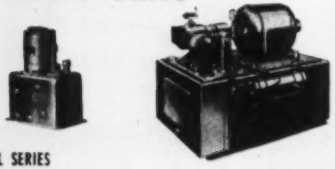
"The Finest Money Can Buy!"

The typical Denison HydrOILic Pumps and Controls shown here have proved their *extra* capacity for continuous, heavy-duty service. Many are built for 5000 psi duty, yet cost no more than other makes of lower rating.

Comparison will prove to you why more and more users, year after year, insist on Denison HydrOILic Pumps and Controls for circuit needs of every type. *Write for bulletins covering your needs.*

The DENISON Engineering Co.
1189 Dublin Road, Columbus 16, Ohio

PUMPING UNITS



SMALL SERIES

Self-contained, vertically mounted units for 2 to 11 gpm requirements. Single-panel assembly of operating components. 15 models cover any circuit need from 400 to 3000 psi. 16 to 35-gallon reservoir capacities. Automatic water-cooled oil coolers available for heavy, continuous service. Bulletin PU-3

LARGE SERIES

High-pressure pumping units in 22 models for circuits up to 5000 psi. Axial piston pumps. Constant or variable-volume delivery of 10, 20 and 35 gpm . . . volume control by handwheel, stem, or pressure compensation. All operating components mounted on reservoir top. 2-pass automatic heat exchangers, available for extra heavy duty. Bulletin PU-4

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NEW EQUIPMENT
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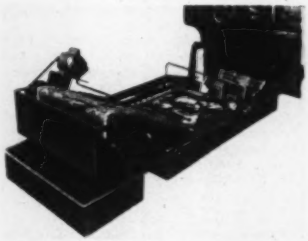
The Delpark filter is a continuous, self-cleaning gravity filter. It filters solids from liquids that will flow by gravity through filter material and discharges the solids, in a relatively dry state into an outside container.

The filter material in the form of endless belting, rests on and conforms to, a flat endless conveyer of open construction. Sloping sides form a shallow pool of the conveyer and an inclined discharge ramp provides for the removal of filtered solids.



The filtered solids are discharged from the endless belt at the end of the ramp into the disposal container. In use in many industrial plants, Delpark industrial filters are used for numerous filtering applications. Among these other uses are filtering of oils used in run-in of engines, gears, transmissions, test stand oil for hydraulically operated parts, quenching oils, and parts washing solvents.

Delpark coolant filters, in many cases fit into or over existing coolant tanks, and since full tank capacity can be utilized, due to no sludge accumulation, smaller tanks can sometimes be substituted.

Capacities range from 2 gpm to units capable of filtering 1000 gpm.

Delpark endless belt filters are manufactured by the Delpark Corp., Lebanon, Ind., and are sold nationally by the Industrial Filtration Co. of Lebanon, Ind.

Industrial Fan

A new, rugged industrial fan built with either an air handling, a materials handling, or a long shavings wheel is now available from the Westinghouse Electric Corp. The fan is made in 11 sizes with capacities ranging from 670 to 44,000 cfm and pressures up to 16 in. water gage. The air-handling wheel has backwardly inclined blades featuring low power consumption over a wide range of volumes and pressures. It is particularly suitable for exhausting smoke, fumes, and light dusts. The heavy-duty, straight-bladed, side-plated, materials-handling wheel combines high an efficiency with its materials-handling features. Conveying of sawdust, granular materials, and chips are typical applications of this type of wheel. The long shavings wheel has no side plates and has been specifically designed for handling long stringy fibers.

Standard accessories for the fan include both bolted and quick-opening-type access doors, flanged outlets and inlets, and outlet dampers. It is available with a variety of special coatings, and can also be built of special metals to meet explosionproof or anti-corrosive specifications. For high temperature applications, special cooling aecessories are available.

Write Westinghouse Sturtevant Div., 200 Readville St., Hyde Park, Boston 36, Mass.

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NEW EQUIPMENT
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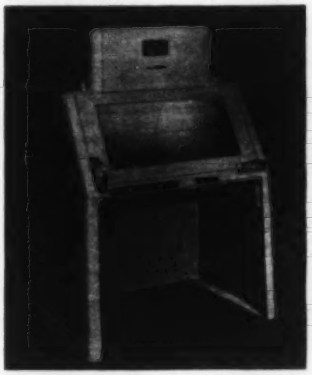
Universal Telereader

Faster, more accurate measurements of film and oscillograph records are now possible with the development of the Universal Telereader, Telecomputing Corp., Burbank, Calif., announces.



The Universal Telereader measures records ranging from 16 and 35-mm film to 12 in. oscillograph paper up to 100 ft in length. It can handle either translucent or opaque records.

Three interchangeable projection lenses are provided with the Telereader to permit record magnification of 2×, 4× and 11×, depending on the need.

When used with companion instruments such as Telecomputing's Telecordex and a summary punch, the Universal Telereader can print its measurements in decimal form on a typewriter supplied with the Telecordex, as well as recording such information into punched cards.

Chrome Carbide Samples

A sample test kit containing a variety of shapes and sizes of the new Grade 608 cemented chrome carbide is now available from Carboloy Dept. of General Electric Co., 11177 East 8 Mile Road, Detroit 32, Mich. The kit has been assembled to enable product designers, development engineers, process engineers, and metallurgists to make a wide variety of metallurgical, physical, and chemical tests to check the corrosion, abrasion, and erosion resistance of the new carbide in specific applications.

Grade 608 Chromium Carbide, a strong and stable nonmagnetic metal that contains 83% chromium carbide, 2% tungsten carbide, and 15% nickel, has about the same density as SAE steel and approximately the same thermal coefficient of expansion as steel. It has shown extremely high resistance to acids, salt spray, steam erosion, and high-temperature oxidation—combined with good abrasion resistance. Series 600 Chrome Carbides are as machinable and hard as tungsten carbide. Fabrication and finishing techniques for these metals are identical to those for tungsten carbide.

The kit contains: three $^1/_4$-in. square bars 2 in. long; two $^1/_4$-in. square bars 1 in. long; three $^1/_2$-in. OD $^5/_{16}$-in-long bushings with a $^3/_{16}$-in. ID; one $^1/_4$-in-diam rod 1 in. long.

NEW 6-7000 lb FORK TRUCKS BY CLARK EQUIPMENT

They're as Modern as your planning for the Future

The NEW, Improved UTILITRUCS... set a new high in fork-truck design and construction

Advanced features insure longer life, lower cost, greater ease of operation, and increased work capacity. They are rougher and tougher than any handling job in the 6,000-7,000-pound range, that any stevedoring boss, foundry boss or steel-mill foreman can dream up.

The detailed features of these new UTILITRUCS show why they master the ever-increasing burdens put upon materials handling equipment by modern production methods and techniques. See for yourself why they set new high standards for the fork-truck industry.

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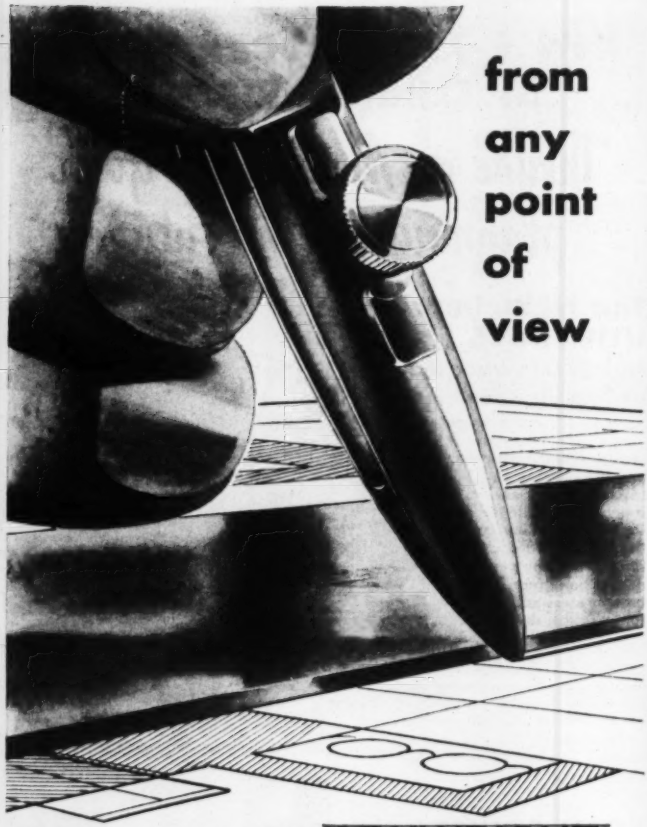

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AMERICA'S STANDARD FOR OVER 30 YEARS

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The individual pieces of Grade 608 Chrome Carbide are assembled in an attractive transparent plastic case. Price of the complete sample kit, including a technical bulletin, is $10.75.

Inverted Overhead Conveyer

Adaptations of standard conveyer systems are solving daily many unusual material-handling problems, according to the Lamson Corp., Syracuse, N. Y. When loads must be carried around building obstructions and kept horizontal while traveling up and down inclines, an inversion of the overhead, trolley-type conveyer will do the trick.

All sorts of commodities—sheets of printed material, open containers of chemicals, open boxes of small machine parts, containers of in-process food stuffs, etc.—can be transported from final production to packing and shipping areas without the danger of shifting (in the case of stacked loads) or spilling (in the case of boxes of small particles) on this type conveyer.

The installation shown is one at the Crowell-Collier Publishing Co., Springfield, Ohio, where trimmer lifts of magazines are wormed around building obstructions and carried to this plant's packing and shipping departments. This conveyer also transports loads up and down sharp inclines without the magazines shifting, thus eliminating the necessity of rejogging before reverse stacking.

In operation, trimmer lifts arrive at the shipping department on this special inverted conveyer, are picked up by shipping-room personnel, and reverse stacked on a "Carousel-type" conveyer in uniform loads for packing. As a result, Crowell-Collier's packing and shipping operations are speeded and manual handling is kept to a minimum.

Keep Informed

NEW EQUIPMENT
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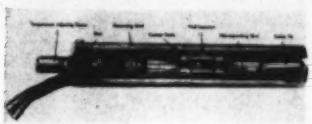
Compact Thermostat

In selecting a temperature controller for a particular piece of equipment, some thought must be given to the conditions under which the thermostat will operate. Will the thermostatic unit be subjected to unusual physical conditions, such as continual vibration? How should it be installed to obtain the maximum sensitivity? What space limitations are involved?

These problems were encountered in the design of a food packaging machine which operates at the rate of 80 to 100 cpm. The machine automatically packs tea, granulated sugar, and other products in individual packets and seals the packets by stamping them between a hot platen and a pressure block. The machine contains two platens, each of which is heated by a pair of internally located 150-watt electric heaters. In order to closely control the 325 F sealing temperature, a Thermoswitch, a precision thermostat manufactured by Fenwal Inc. of Ashland, Mass., was installed directly in the



platen. The Thermoswitch is set so that its contacts remain closed until its operating temperature, 325 F, is reached. Thereupon, the contacts open and shut off the power to the heaters until the platen temperature again drops below 325 F.

The construction of the Thermoswitch makes it highly suited to this application. Because of its compactness (approximately 5 in. long and $^{3}/_{8}$ in. in diam), it could be conveniently installed in the platen. The inherently high sensitivity of the thermostat, ± 0.1 F, coupled with its location directly in the medium being controlled, assures a rapid response to temperature variations and permits precise control over operating temperatures.

Most important, perhaps, the unit can withstand the repeated vibrations caused by the collision of the rapidly cycling platen with the pressure block. This insensitivity to shock results because the metal struts, on which the switch contacts are mounted are assembled under compression. This provides a high degree of rigidity which prevents the contacts from responding to physical shock or motion. The contacts actuate only in response to temperature change which causes a difference in amount of elongation (or contraction) between the outer cartridge and the internal strut assembly.

Spring-Centered Valve

Valvair Corp., 1009 Beardsley Ave., Akron 11, Ohio, announces the addition of a new spring centered neutral valve to its regular line of air control valves. Maintenance free operations of over 20 million cycles may be expected from these valves.

Features are as follows:

Position—In neutral position all ports are blocked—open neutral position may be furnished upon request.

Types—Three and four-way piped exhaust.

Sizes—$^{1}/_{4}$, $^{3}/_{8}$, $^{1}/_{2}$, $^{3}/_{4}$, 1 in.

Styles—Knob, lever, foot, clevis, double-acting cylinder, and double-acting cylinder with solenoid pilot valves.

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to permit greater load-speed capacity

Amerigear
*Trade Mark Reg.
COUPLING
The Proven Gear-Type Coupling With Fully Crowned Teeth . . . A Major Improvement In Gearing
Pat. & Pat. Pending

THIS FUNDAMENTAL IMPROVEMENT in gear tooth design practically eliminates all "end tooth and tip" contact and provides greater freedom of axial movement. This tooth design accomplishes tight fit on the crown as well as on the flanks. It is the first gear tooth on which all the load is carried on strong flanks rather than tooth edges. It reduces backlash to a minimum. These advantages, plus thrust compensation, and correction for angular and lateral misalignments give maximum relief from coupling failure grief.

Amerigear Couplings, made in several standard types, are available for standard shaft sizes and a wide range of speed and load capacities. Catalog of standard type Amerigear Couplings is available on request. Amerigear Power Transmission Engineers are available for consultation.

AMERICAN FLEXIBLE COUPLING COMPANY

Originator of the Amerigear Fully Crowned Tooth

Sales Offices in Principal Industrial Centers

ERIE, PA., U. S. A.

AFFILIATE OF J. A. ZURN MFG. CO.

Write on your Business Letterhead for further information regarding *Amerigear Couplings* with the *Fully Crowned Teeth* and Catalog 501.

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The Original "Oldham Type" American Flexible Coupling

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SHOCK AND VIBRATION INSTRUMENTATION 1952 $2.00

A collection of seven papers dealing with applications of shock and vibration instruments for various services, and problems encountered in their design.

DESIGN DATA 2 VOLUMES 1944

CONTENTS OF VOLUME 1, STRENGTH OF MATERIALS $1.50

Stress and Deflection of Circular Plates. Stress Deflection of Rectangular Plates. Circular Beams Loaded and Normal to the Plane of Curvature. Thermal Stress. Torsional Stresses in Shafts having Grooves or Fillets. Factors of Stress Concentration Photoelastically Determined. Stresses in Pressure Vessels. Press- and Shrink-Fitted Assemblies. Working Stresses. Formulas for Calculating: (1) Load, Deflection, and Stress in Helical Compression and Tension Springs, and (2) for the Design of Piping.

CONTENTS OF VOLUME 2, MECHANICS $1.50

Vibration Problems. Balancing of Rotating Apparatus. Harmonic Coefficients of Engine Torque Curves. Shortening the Time of Applying Theoretical Formulas to Solving the Common Design Problems of Uniform, Flat, and Circular Plates. Result of Calculation for the Deflections and Moments in Rectangular Plates with Hydrostatic Loading. Circular Beams Loaded Normal to the Plane of Curvature. Formulas for Calculating Loads, Rotation, and Deflections of Quarter Bends and Tangents of Pipes.

MODERN REHEAT TURBINES AND BOILERS 1952 $2.00

Aspects of reheating treated include design, progress and service experience; advantages and disadvantages of the reheat cycle; normal start-up, quick start-up, normal operation, and shutdown of modern reheat boilers under normal or emergency conditions; and design factors relating to their performance and operation; special features of operation of several new reheat boilers; conversion to centralize control of auxiliaries; reheat steam temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

GAS TURBINE PLANT HEAT EXCHANGERS 1951 $3.00

Provides much needed basic heat transfer and flow friction design data for compact heat exchanger surfaces. Included are descriptions of the 34 surfaces considered, test results, dimensions and a scale diagram for each surface, examples of heat exchange performance calculations, etc.

PRINCIPLES OF OPTIMALIZING CONTROL SYSTEMS AND AN APPLICATION TO THE INTERNAL COMBUSTION ENGINE 1951 $2.00

CONTENTS: General Principles of Operating Systems. Methods of Realizing Optimum Performance. General Principles of Optimalizing Control Systems. Sensitivity Signal Input Optimalizing Controllers. Continuous Test Signal Optimalizing Controllers. Output Sampling Optimalizing Controllers. Peak Holding Optimalizing Controllers. Recovery Time of Optimalizing Control Systems. Output Hunting in Optimalizing Controllers with Operating Component Response Delays. Output Hunting Loss. An Experimental Peak Holding Optimalizing Controller for a Reciprocating Internal Combustion Engine. Summary of the Test of the Experimental Controller.

RECOMMENDED PRACTICES FOR CLEANING TURBINE LUBRICATING SYSTEMS 1952 $1.00

Makes available procedures with respect to the preparation of new turbine lubricating systems, the cleaning of lubricating systems after service, and the preparation of turbine oils. Recommendations are based on information furnished by turbine builders, operators, oil suppliers, and consulting engineers.

SMALL PLANT MANAGEMENT 1950 $6.00

This practical Guide to know-how management is based on a study of small plant activities in different industries throughout the country. It thoroughly treats every significant management topic from the principles of scientific management to financing; banking; accounting; legal requirements; taxes; labor relations; unions; plant planning; organizing; operating and controlling; and obtaining best facilities, materials, productivity, and sales.

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Medium Controlled—Air, water, oil, or inert gases.

Pressures—To 300 psi.

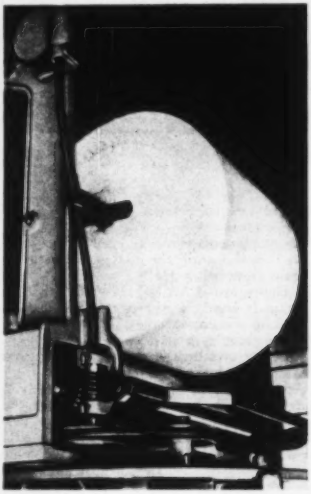
Application—To stop and hold single or double-acting cylinders in any position.

Construction—Bronze body, stainless-steel stem, hard chrome plated, Hycar "O" ring packers, brass spacers, cadmium plated springs.

Folder "K" completely describes this new line of valves.

Flexible Shaft Power Drive

The adaptability of flexible shaft power drives to unusual operating conditions is demonstrated in this installation built by Elliott Mfg. Co., Binghamton, N. Y., for the manufacturer of the knitting machine shown in the photograph.



Use of the flexible shaft drive in this instance made it possible to go around one of the supports of the machine without the use of miter gears, to simplify design, and to reduce the number of parts.

Because the mechanism has a bobbing motion, there is considerable strain centered in one area. Elliott engineers designed a special core, specifying types and grades of wire that are fitted to meet the operating conditions in this particular installation.

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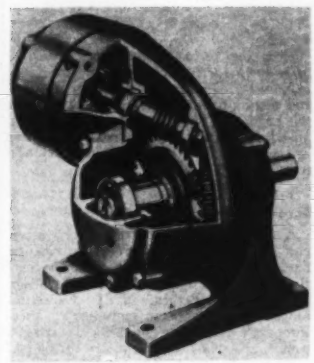
Right-Angle Worm-Gear Motors

An entirely new line of low-speed right-angle worm-gear motors has been placed in production by U. S. Motors. Introduced as Type GW Syncrogear, the design presents numerous exclusive features not heretofore available in low-speed motors. Type GW incorporates a cantilever design to protect gear alignment. Mounting stresses are absorbed by a rugged single unit pyramidal base with "spread eagle" feet. The gear and motor housing are free from distortion. It embodies splash lubrication, a hardened and ground worm, leakproof oil seal, and asbestos-protected windings. It has self-locking brake action. The parabolic contour of the



motor housing gives the unit a pleasing appearance. This new motor is built in speed ranges from 20 to 155 rpm and gear ratios up to 58.1. Horsepower ranges from 1/4 to 3. It is made in both 3-phase and single phase. The GW Syncrogear can be installed horizontally or upright and can be provided with a footless flange mounting. Other modifications provide variable speed, splashproof design, and total enclosure.

For full details write to U. S. Electrical Motors Inc., P. O. Box 2058, Los Angeles 54, Calif., for Type GW Syncrogear Bulletin No. 1650. This literature illustrates Type GW in various modifications, acompanied by interesting cut-open views in quadra-color, with enlarged details of distinctive features and processes of manufacture.

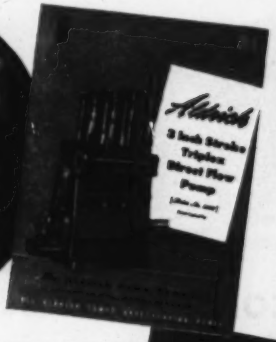
Human Centrifuge

The world's largest and most powerful human centrifuge—a machine to subject pilots to extreme gravitational conditions encountered in sonic-speed aircraft—has been put into operation at the Naval Aviation Medical Acceleration Laboratory, Johnsville, Pa.

Built by the McKiernan-Terry Corp. of Harrison, N.J., the centrifuge is capable of accelerating from a dead stop to 173 mph in less than 7 sec. It will speed up from zero to approximately 90 mph in 1 1/2 sec.

The giant "whirligig" is capable of exerting a force equal to 40 times the gravitational pull of the earth on a pilot seated in a gondola at the end of a 50-ft rotating arm. It will be used by the Navy to evaluate human tolerance to acceleration and to study the physiological systems which limit the tolerance.

HERE'S HELP



☐ 10 to 50 hp

50 to 275 hp ☐

☐ 300 to 900 hp

☐ 5 to 125 hp

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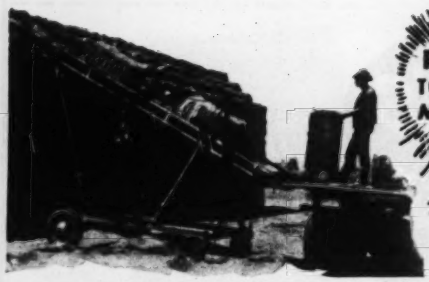

WISCONSIN-Powered TECO STACKER

An interesting design and functional feature of this unique Wisconsin Air-Cooled Engine application by Thompson & Gill, Inc., of Madera, Calif., is the mounting of the engine on a swinging frame below the conveyor. The power unit (a Model AKN Single Cylinder Engine) retains its vertical position regardless of the loading angle of the stacker which can handle bales, bags or boxes, stacking to a height of 18 ft.

In the design and manufacture of a great variety of specialized power equipment, Wisconsin Air-Cooled Engines "get the nod" because of their adaptability to fit the machine as well as the job, thanks to extremely compact design, light weight, and all-weather serviceability . . . plus heavy-duty construction and performance.

You can't do better than to specify "Wisconsin" for your equipment. Detailed data and engineering cooperation on request.

Models ABN, AKN, AEN 4-cycle single cylinder, 3 to 8 hp. Other models, up to 30 hp.

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

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To obtain these operation requirements, the centrifuge is powered by one of the largest vertical d-c motors ever built. Supplied by the General Electric Co., the huge 180-ton drive has a rating of 4000 hp and can develop 16,000 hp momentarily at 48 rpm.

Special electronic controls, also furnished by G.-E., are operated from a blister suspended from the ceiling of the centrifuge room. From this blister, varying speeds of the arm and the position of the gondola can be controlled by one man.

The spheroidal aluminum gondola is suspended in double gimbals which can be rotated by means of motors mounted on the arm. Thus, a man seated in the car can be somersaulted or tipped into any position while he is swept around the large circle described by the arm.

Since the human "guinea-pig" is visible to researchers only when the centrifuge is motionless, high-speed television, x-ray, and motion-picture cameras are mounted in the gondola. This recording equipment is linked to control and observation stations by means of slip rings on the machine's rotor shaft.

Screw Pump

A new internal gear and bearing type screw pump for positive displacement of lubricating fluids or semifluids is announced by the Sier-Bath Gear and Pump Co., Inc., 9252 Hudson Blvd., North Bergen, N. J. Capacities range from 1 to 700 gpm, and discharge pressures are 1000 psi for viscous liquids, and 500 psi for light oils. The pump is a companion product to the recently announced Sier-Bath "Bracket Type" screw pump, external gear and bearing type, used for moving non-lubricating fluids and semifluids.

Special points of interest in the new Internal Gear and Bearing Type are (1) the heavy duty roller bearings just inboard of the timing gears where radial load is heaviest, (2) lock nuts behind the timing gears for faster, simpler repairing, and (3) double-row angular contact ball bearings at the rear end which position the rotors axially for less wear on the bearings and timing gears.

Other advantages are interchangeable rotor screws for inexpensive over-hauling; no metallic contact between the rotors for long rotor life and continued high volumetric efficiency—which, in turn, reduces wear caused by erosion—only suction pressure on stuffing boxes for reduced leakage, longer packing life, and easier servicing; direct-connection up to 1800 rpm for use with high-speed motors.

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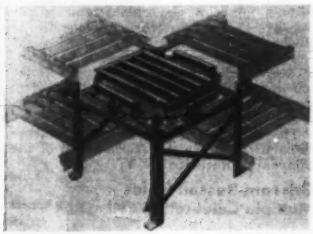
Roller Turntable

A roller turntable has been developed by Lamson Corp., Syracuse, N. Y., for incorporation into roller gravity conveyer systems. This turntable adds versatility to any type of conveyer system. It can be locked in position so that flow of packages is in one direction only. Otherwise, it makes possible a change in direction of packages, cases, or cartons that are being processed during production or shipping.



The unit consists of a roller section and two auxiliary rolls and is ruggedly built for heavy-duty operation. The swivel section revolves on casters on a center point. A simple foot treadle is provided to lock the turntable into position. It is particularly designed for lighter loads because the man must revolve the load.

Business Notes

Rolling Mill

A huge new rolling mill, costing approximately $4,500,000 and capable of producing extra-wide tapered sheet and plate for aircraft, will be installed at Aluminum Company of America's Davenport, Ia., works by late 1953.

Equipment for the mill—which will be one of the largest and most modern in the aluminum industry—will be designed, installed and operated by Alcoa under terms of a lease arrangement with the United States Air Force's Air Materiel Command.

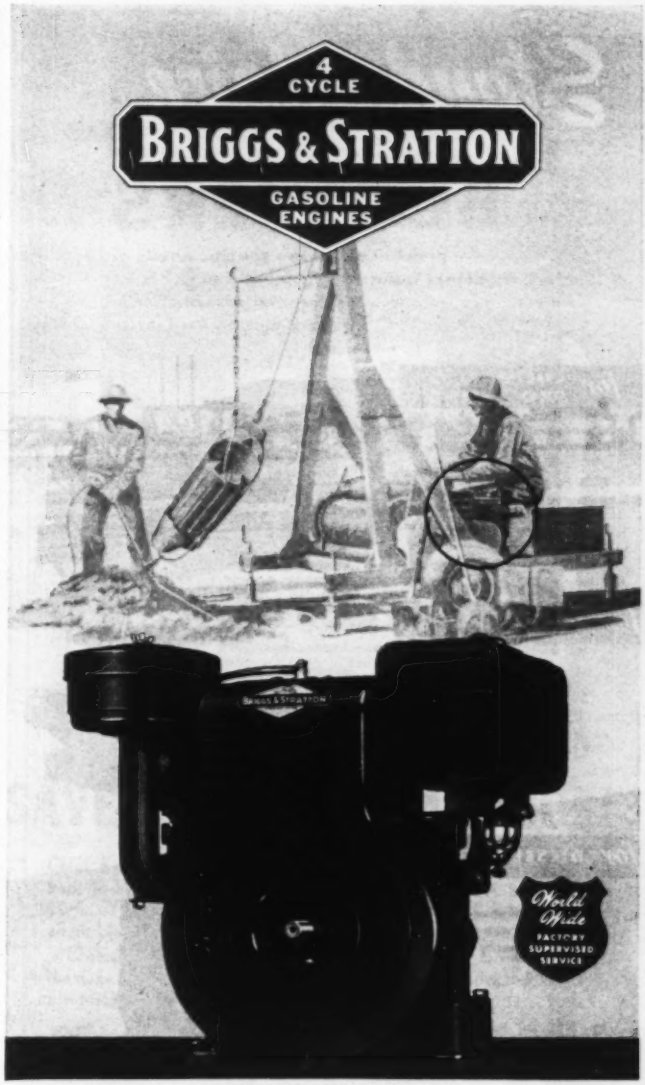
The mill, capable of rolling widths up to 10 ft through four-high stands of rolls, will be able to handle hot or cold ingots, and it will be reversible.

Davenport was selected as the mill site because of the other ultra-modern facilities already existing there, such as large heat-treatment furnaces and wide continuous rolling equipment.

Supplementary facilities, including an intermediate leveller and preheat and aging ovens, are provided for under the government contract to complement the rolling mill.

Tapered sheet and plate are used in fabrication of aircraft wings. The sheet's thickest end is placed nearest the fuselage of the plane; thus, the sheet tapers thinner as it reaches toward the wing tips, where not as much strength is required.

The principal design advantage of tapered sheet and plate over that of uniform thickness sheet or plate is a weight saving up to 35% without loss of strength.



Preferred power on sewer cleaning machines and related equipment — the world's most widely used single-cylinder gasoline engines on machines, tools, appliances used by municipalities, industry, construction, railroads, oil fields, and on equipment for farms and farm homes.

YEARS ahead in design, performance, value — Briggs & Stratton single-cylinder, 4-cycle, air-cooled gasoline engines are *preferred* whenever dependable air-cooled power is required. Briggs & Stratton Corporation, Milwaukee 1, Wisconsin, U.S.A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

Standardaire

AXIAL FLOW POSITIVE PRESSURE

BLOWERS

provide air to the specific needs of many important industries because Standardaire Blowers are unique in design and construction—unequalled in quality and performance.

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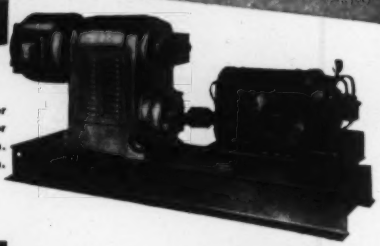
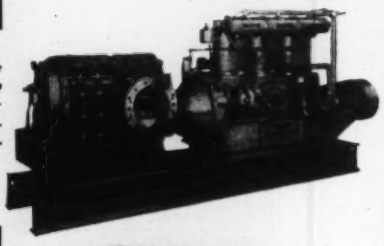


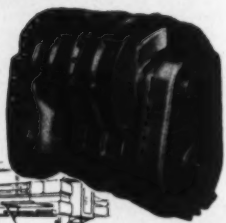
Standardaire Blower with Varidrive Motor to deliver 780 c. f. m. at 1750 r. p. m.

for SEWAGE PLANTS

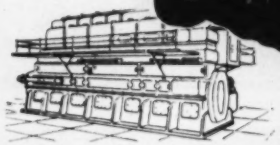


Standardaire Blower with Climax Engine using sewage gas—to deliver 2100 c. f. m. at 720 r. p. m.

for DIESEL ENGINES



Standardaire Blower with 6000 c. f. m. capacity at 12 p. s. i.



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BLOWER-STOKER DIVISION

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Tapered sheet on the new mill will be produced in lengths exceeding 33 ft. Present equipment limits the production of rolled tapered sheet to widths slightly over 5½ ft and to lengths a little over 25 ft.

The extra wide and long sheet can replace two or three narrower sheets and thus eliminate many costly joining operations during construction of both civilian and military aircraft.

Instruments Film

"Information At Work" is the title of a 30-min, full-color film on instruments put out by Taylor Instrument Companies of Rochester, N. Y.

The film traces the development of instruments from those which do a relatively simple job to today's remarkable products used to indicate, record, and control the most complex processes.

The film may be booked without charge through the Public Relations Dept. of the company at Rochester, N. Y.

Griscom-Russell Holds Multiple Celebration

The Griscom-Russell Co. of Massillon, Ohio, held a "Family Day" early in June to mark the 85th birthday of the Company, and at the same time to signalize the consolidation of its entire executive, administrative, engineering, and general sales departments at Massillon.

The Company, which is the largest exclusive manufacturer of heat-transfer apparatus, originally moved its manufacturing operations to Massillon in 1912. Since then, its facilities have been continuously expanded to accommodate its steadily increasing business; and last Fall the Company moved its general offices from New York City to Massillon to provide most efficient co-ordination of the work of all departments.

Westinghouse to Build $6 Million Lab

Ground was broken recently for a $6 million steam and gas-turbine development laboratory at the South Philadelphia Works of the Westinghouse Electric Corp. Actual construction of the four-story, brick and structural steel building will begin late this summer, and will take about a year to complete. It will employ a staff of nearly 100 engineers and technicians, and initially will conduct special research for the U. S. Air Force.

This new research center will be the most modern engineering development laboratory of its kind in the nation. It is being built to maintain the flow of knowledge necessary for future improvements and new discoveries and developments in power generating equipment.

Steam and gas turbines and their components up to 15,000-kw capacity will be accommodated in the main test hall of the new research building. Three 8000-hp axial-flow compressors will provide facilities for compressor development for gas turbines and the Air Force wind tunnel. Separate laboratories will be provided for hydraulic, heat exchange, mechanical, aerodynamic, combustion, and model shop activities. The laboratory powerhouse will include a huge boiler providing 150,000 lb of steam per hr at a temperature of 900 F. A reheater at the laboratory, used in conjunction with reducing valves, will make available steam at any desired pressure up to 1500 psi and at temperatures ranging from 800 to 1100 F.

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Alco Products Film

"The Alco Products Story" is a new industrial movie based on the development and manufacture of products for the oil, chemical, and power industries, by the American Locomotive Co. The 15-min, 16-mm, black-and-white film was produced by the company for its Alco Products Div., with plant and headquarters at Dunkirk, N.Y.

The film demonstrates engineering and production teamwork in all stages of manufacture. It describes how products are developed and how facilities, machines and manpower are co-ordinated for efficient output. One illustration of this is a sequence on the development of new manufacturing techniques used in the production of nickel-plated pipe for the Atomic Energy Commission.

Prints of the film will be available to business groups and professional engineering societies on request from Public Relations Dept., American Locomotive Co., Schenectady 5, N. Y.

Honeywell Adds new Jet Research Lab

A new jet-engine laboratory, believed to represent the most comprehensive engine analog work ever attempted by a control manufacturer, is being established by the Aeronautical Div. of Minneapolis-Honeywell Regulator Co. to speed development work on jet-engine controls.

Equipped with a network of highly complex electronic computers, controllers, and relays, the new facilities, which include a separate building for this work, will permit jet controls to be designed and proved without ever leaving the ground. Not even an engine will be needed.

The electronic system, heart of which is an analog computer, makes it possible to simulate the characteristics of any jet engine under all kinds of flight conditions. Performance of controls is recorded automatically. Engineers then can quickly determine whether the engine "likes" the type of control being tested.

Duplication of the whole gamut of engine positions—idle, takeoff, cruise, augmented thrust—and electronic injection of such flight conditions as speed, altitude, and fuel temperature gives the engineers a much wider range of experiment than flight testing.

The research program requires large stocks of jet fuels to test controls such as those governing fuel flow, tail cone area and fuel temperature. With a capacity of 50,000 lb of fuel flow an hour, the new laboratory is expected to be the largest in the country from that standpoint.

Aldrich Commemorates 50th Anniversary

The Aldrich Pump Co., Allentown, Pa., is one of the oldest and one of very few companies specializing in the manufacture of reciprocating power pumps—pumps ranging from 5 to 2400 hp. This company was originated as The Aldrich Pump Dept. of The Allentown Rolling Mills. The latter company, with a background of almost 107 years, ended its existence on November 30, 1951, through merger into The Aldrich Pump Co.

Today, The Aldrich Pump Co. manufactures reciprocating pumps for high-pressure service such as the operation of presses for forging or extruding, for die-casting machines, plastics and rubber molding, oil field water

Small Capacity • Medium Duty
SIDE SUCTION PUMPS
Close-Coupled • Flexible Coupling • Belt Drive

CAPS 5 to 75 G.P.M.

Ideal as part of Equipment Manufacturer's product, such as, air conditioning units, cooling towers, evaporator coolers, milk coolers, hot water circulators, etc. — and general service. Speeds 1750 to 3500 R.P.M.

HEADS 8 to 100 ft.

Type JMC Aurora Close-Coupled Pump

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AURORA Always PUMPS — AURORA PUMP COMPANY

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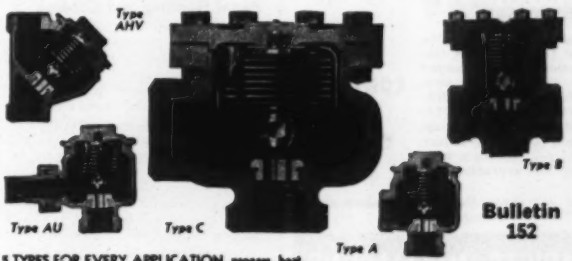
In This Plant Nicholson Traps

SAVE 10% IN STEAM COSTS

Chief Engineer H.F.D. stated, after Nicholsons replaced mechanical traps in his plant: "Saving in steam waste cut our fuel cost at least 10%. Yet application temperatures were up 30°–40°. And relief of all air binding effected faster warm-up."

Operate on lowest temperature differential, 2 to 6 times average drainage capacity, maximum air venting. For other advanced Nicholson features send for Bulletin 152.



Bulletin 152

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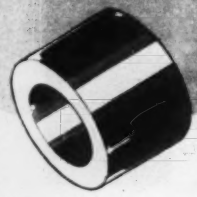

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

flooding and pipeline pumping, chemical handling, pumping liquid hydrocarbons, steel mill descaling, boiler feeding, and other uses.

Among many outstanding developments, Aldrich was first to produce high speed pumps with crankshaft speed of 60 rpm (1903) and 120 rpm (1918). The company was also first to develop porcelain plungers, to develop the variable stroke triplex pump (1926), to build 5, 7, and 9 plunger pumps, to advance crankshaft speed to 225 rpm (1939) and, in 1949, to design and build the direct flow pump with speeds of 500 rpm for the 3-in-stroke pump, 360 rpm for 5-in-stroke pumps and 300 rpm for 6-in-stroke pumps.

Very active in various phases of defense production, Aldrich is now in the process of manufacturing 800 and 1300-hp, 4500 and 5500-psi pumps for use in the huge, newly expanded press program. Recently, The Aldrich Pump Co. supplied an Aldrich-Groff controllable capacity "Powr-Savr" pump and several 6-in-stroke triplex and multiplex Aldrich direct flow pumps, equipment totaling 2425 hp, for use on the largest waterflood project in operation at the present time.

Westinghouse Holds Materials-Handling Course

Supervisors and foremen of the Westinghouse Elecrric Corporation's East Pittsburgh Works are currently participating in a 12-session materials-handling course. Designed to help in the reduction of $100,000,000 cost of moving materials in 1951 in Westinghouse, the course is open to selected representatives of all of the departments of the plant.

Topics of discussion include plant layout, problem analysis, improvement procedures, techniques, equipment, in-process handling, packaging, storing, and other subjects considered to be of prime importance in good materials handling. The weekly two-hour sessions are filled with lectures, movies or slides, and a discussion period. In addition, printed matter pertinent to the particular phase of materials handling being covered is distributed to the class.

As a part of the course, class members are required to undertake a materials-handling project in their respective departments and work them through to completion. Occasionally, the class goes into the shop to observe some member's project and to discuss the various features.

Panel Heating and Cooling

Pittsburgh's 30-story Alcoa Building is the nation's first skyscraper equipped with a panel heating and cooling system that requires no radiators or conventional air-conditioning units around the walls.

On each floor, aluminum ceiling panels are attached to $\frac{1}{2}$-in. aluminum pipe grids suspended from turnbuckles. Through this pipe, hot water will be circulated for winter heating and cold water for summer cooling. Panels are perforated for acoustical control, and a 1-in. blanket of fiberglas insulation on the ceiling pans is designed to absorb sound passing through the perforations.

Ventilating air, which is to be cooled during the summer cycle, will be supplied to each floor by primary air fans in the basement, on the 14th floor, and in a machinery penthouse on the roof. Local air-blending units and small fan rooms on each floor handle the ventilating air for individual rooms. All ductwork, fittings, and grilles will be of aluminum.

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Hot water for the panel heating coils will be furnished by steam converters in the basement. Chilled water circulated in the coils for summer cooling is to be provided by two centrifugal refrigerating compressors having a total capacity of 1250 tons of refrigeration.

Design specifications of the heating-air conditioning system call for maintaining a minimum temperature of 70 F indoors when it is 0 F outdoors and a maximum of 80 F when the outdoor temperature rises to 95 F. Control of the system will be fully automatic, with each floor individually zoned to obtain desired comfort conditions. Theremostats are installed in strategic locations for flexibility in controlling the system. Average humidity in the building will be controlled to a maximum of 45%.

Dravo Corp., Neville Island, Pittsburgh 25, Pa., the heating, ventilating, and air conditioning contractors for both the Alcoa Building and the 525 William Penn Place Building (home of U. S. Steel-Mellon Bank), said that these buildings are setting the trend in the Pittsburgh area for the installation of central air-conditioning systems.

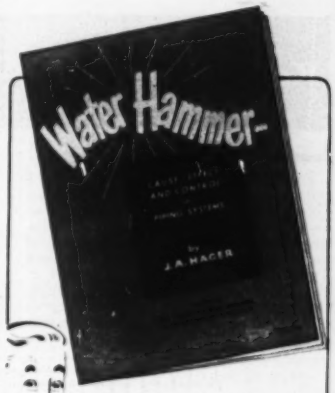
Latest Catalogs

Vibration Meter

Consolidated Engineering Corp., Pasadena 8, Calif., has issued a new, 4-page bulletin, No. CEC 1505B, describing the 1-110B vibration meter, an instrument which gives direct readings of both linear and torsional velocity and displacement, allowing rapid, easy calculation of the vibrational characteristics of machines and structures. Although used by test engineers for the most exacting vibration studies—one of its most widespread applications is in turbojet engine acceptance tests—the instrument is portable, simple to use and its operation does not demand highly experienced personnel. Five ranges of sensitivity allow the meter's full-scale deflection to represent from 0.005 to 0.5 in. peak-to-peak vibratory displacement. All controls are grouped about a single, easily read meter whose scale is calibrated for direct readings of both velocity and amplitude when used with standard CEC vibration pickups.

Two-Drum Boilers

A 2-drum boiler of the integral furnace type is described in the new Erie City V-C bulletin, which includes information and dimensional data on both the Erie City 3-VC and 4-VC designs. Both types of boilers are available in a variety of sizes for oil, gas, and stoker firing. Typical installations for the various types of firing are shown. These Erie City boilers are available in two distinct arrangements—the 3-VC with a 42-in-diam top drum and the 4-VC with a 48-in-diam top drum. Both boilers have 38-in-diam lower drums and 2½-in-OD tubes throughout. Capacities are offered in a wide selection to suit requirements with design pressures covering a wide practicable range. Each unit is furnished with water-cooled furnace walls, internal steam scrubber, and steel casing. Construction details of the 2-drum boiler are included in the V-C bulletin available from Erie City Iron Works, Erie, Pa.



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Spark Ignition Gas Engines

Four-cycle gas engines of 5, 6, 7, and 8 cylinders, manufactured by Worthington Corp., Harrison, N. J., are described in an 8-page bulletin No. S-550-B18A. The bulletin includes pictures and specifications of the totally enclosed gas engines, designated Type DDG. They feature a 15-in. bore × 17 1/2-in. stroke in 50 and 60-cycle operation. Other Worthington spark ignition gas engines of the nonsupercharged types are also briefly described.

Welded Steel Boiler Tubes

Data of interest to engineers associated with the production of steam for heating, power, and processing are included in a new bulletin issued by The Tubular Products Div. of The Babcock and Wilcox Co., Alliance, Ohio. In addition to general information, the bulletin, No. TB-331A, contains tables of maximum allowable working pressures of electric-resistance-welded steel boiler tubes for fire-tube and water-tube boilers and weights per foot for various tubing sizes.

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Shell Molding

The Copper Alloy Foundry Co., Hillside, N. J., announces the publication of an 8-page technical booklet covering the shell-molding process for producing stainless-steel castings. This fully illustrated booklet describes in detail the various operations at Cooper Alloy tied up with the production of shell-molded stainless-steel valves, fittings, and castings, and discusses such advantages of the process as higher yield, closer tolerances, smoother finish, and minimized cleaning problems.

Packaged Air-Conditioning Systems

A specification sheet describing two packaged air-conditioning systems, one of 10 tons and one of 15.5 tons capacity, has been published by Worthington Corp., Harrison, N. J. Cooling dehumidification, ventilation, circulation, cleaning (and heating if desired) is provided by the packaged systems in five sizes. The size range permits unit selection in balance with encountered loads. The SCY-1050 unit features two 5-hp compressor motors, a 1 1/2-hp fan motor, 4000 normal cfm, with a total heat capacity of 120,000 Btu cooling units per hour and 10 tons of refrigeration. The SCY-1550 unit features two 7 1/2-hp compressor motors, a 2-hp fan motor, 6000 normal cfm, with a total heat capacity of 185,500 Btu cooling units per hour and 15.5 tons of refrigeration.

Rototrol Rotating Regulator

A revised 22-page application booklet, No. B-3998-B, on Rototrol® rotating regulators for the steel industry is available from the Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa. This edition presents up-to-date information on the Rototrol's functions, applications, and accomplishments as a control for steel producing and processing equipment. Fourteen different steel-mill applications of Rototrol are described with circuit diagrams, photographs, and sketches. The application of Rototrols as speed regulators for skip hoist drives, as tension controllers for winding and unwinding operations, and as power regulators for arc furnaces are typical. Case-history information is provided for each application. Finally, a 4-page section presents the principle of operation of the Rototrol.

Weighing Scales

A new 28-page Condensed Scale Catalog, No. 11, has been released by The Howe Scale Co., Rutland, Vt.

The handy reference features a complete line of modern scales for every industrial need. It includes a selection of a thousand popular standard Howe scales weighing from 1/64-oz to 400 tons.

A compact edition of Howe's complete catalog of 200 pages, the new Condensed Scale Catalog includes complete specifications, spot illustrations, and essential information. A simple index makes it easy to find any scale. The Condensed Scale Catalog is conveniently arranged by types of weight indication. Featured are the Howe scales with beam indication, the tape-drive dial, weightograph projection, and the teleprint electronic remote weight recorder.

The catalog also shows a page of Howe hand trucks, and a listing of its branches with sales and service departments throughout the country.

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Keep Informed — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Industrial X-Ray Equipment

Seven types of x-ray equipment made by Westinghouse for industrial application are described in a 4-page folder, "Seven Industrial Eyes." The folder contains pictures of each type of x-ray equipment with a brief description of how each is used. The units described are: (1) Single-column tube stand unit; (2) industrial jib crane unit; (3) ultrahigh-speed radiograph unit; (4) mobile unit; (5) equipment for mass inspection of parts; (6) wall-mounted industrial x-ray unit; (7)thickness gage. A post card for requesting more detailed information on any of the equipment described is included with the folder. For a copy of this booklet, B-4787, write Westinghouse Electric Corporation, Box 2099, Pittsburgh 30, Pa.

Flexible Couplings

A new 4-page bulletin, No. CDC-52, describes Cone-Drive standard bore flexible couplings available from Cone-Drive Gears, Division of Michigan Tool Co., 7171 E. McNichols Road, Detroit 12, Mich. Tables list capacities, specifications, and ordering information for flexible couplings in 22 standard bore sizes from $^{3}/_{4}$ in. to $6^{1}/_{8}$ in. for applications on Cone-Drive worm shafts, Cone-Drive gear shafts, and electric motor shafts. Illustrations include exploded views of the coupling components and assembly and disassembly procedures. Specifications for special couplings including mill motor, spacer vertical shaft and floating shaft type designs, all with custom bores, are listed. Service factor tables and design formulas for selecting correct coupling sizes to suit various applications and horsepower requirements are also included in the bulletin.

Cylinder-Finish Tubing

A new bulletin, No. R-7, on Rockrite cylinder-finish tubing with greatly improved tolerances for hydraulic and pneumatic cylinders that permit standardization and savings in total cost of finished mechanism, has been announced by Tube Reducing Corp., Wallington, N. J.

The new bulletin illustrates why Rockrite compression-formed tubing eliminates expensive machining of cylinder-bore or individual pistons for clearance adjustments, formerly necessary due to tolerances of cold-drawn tubing. A cold-drawn tube $3^{3}/_{4}$-in. O.D. usual variation in I.D. is +0.005 and −0.015 compared with Rockrite tube variation in I.D. of +0.000 and −0.008, or a difference between the two tubes of 0.012 in. in total tolerance.

The bulletin shows how the Rockrite process in addition to producing closer bore tolerances also tends to iron out pits, scratches, or other irregularities typical of both the outside and inside surfaces of the hot mill product which results in the superior surface finish typical of Rockrite cylinder-finish tubing. In no part of this operation is there any action such that longitudinal scores, or scratches, may develop. The metal is not drawn through a die over a mandrel. In this process semicircular tapered grooved dies roll back and forth to compress the metal against a precision-sized polished mandrel which also controls the inside diameter.

Illustrated typical applications and data table on various tube sizes frequently met in user specifications are also contained in this new bulletin.

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Prepared to meet the needs of shopmen and draftsmen for a reference tool that would facilitate finding thread dimensions, this condensation of the standards covering American and Unified Screw Threads and their Gaging, contains only the most used and essential standard dimensions, a concise description of the thread features and their applications, and other material giving important related information not found in the standards.

CONTENTS

Thread Form Formulas, and Thread Form Data

Standard Thread Series and Their Applications:
Basic Dimensions and Allowances and Tolerances for Coarse, Fine, Extra-Fine, 8-, 12-, and 16-Pitch Thread Series

Thread Classes and Their Applications
Unified Screw Thread Tolerance Formulas

Limits of Size
Classes 2A External Threads and 2B Internal Threads

Special Threads

Selected Combinations of Class 2A

Calculating Any Special Thread

Screw Thread Gages and Gaging:
Gage Limits of Size: Standard Threads, Classes 2A and 2B Series UNC, NC, UNF, NF and 8N to 1½ In. Diameter; Formulas for Gage Limits, Unified and American Screw Thread; Gage Tolerances and Wear Allowances; Lengths of Standard Thread Plug Gage Blanks, Lengths of Standard Ring and Setting Plug Gage Blanks; Marking of Gages

Appendixes:
Stress Area, Drilling for Tapping, Recommended Hole Sizes before Threading, Gages and Gaging Practice, Three-Wire Measurement of Pitch Diameter, Metric Limits of Size.

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Rotary Pumps

Bulletin WQ-50, 8 pages describes Warren-Quimby Rotex pumps and gives sectional and exterior views, dimensions, engineering data, selection charts, etc. Available from Warren Steam Pump Co., Inc., Warren, Mass.

Safety Relief Valve

Cash Acme's bulletin No. 290, describes a completely new Type F 51 ASME approved safety relief valve. The new bulletin is self-explanatory, in describing the new product. The valve is said to have the highest Btu discharge rate of any safety relief valve on the market of comparable size. Bulletin available from A. W. Cash Valve Mfg. Corp., Decatur, Ill.

Heat Treating

The *Heat Treat Review* published periodically for industry by Surface Combustion Corp., is now in its fifth issue. Vol. 3, No. 1, includes excellent articles on "How to Cut Heat-Treat Costs"—in a mass production automotive plant—and "What Builds a Quality Heat-Treat Shop"—for job-lot commercial heat treating.

Applications of the latest in heat-treat equipment and processes are reviewed.

Copies are available from the Editor, *Heat Treat Review*, Surface Combustion Corp., Toledo, Ohio.

Oscillating Conveyers

A big step forward in the standardization and simplification of conveying equipment, resulting in faster delivery and lower cost to customer, has been announced by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill. Positive action Flexmount oscillating conveyers in any desired length can now be ordered and built by the purchaser from factory subassemblies available from stock. These subassemblies are available in 8-in., 12-in., and 18-in. trough widths without waiting for special engineering. In a new book No. 2478, Link-Belt offers a complete guide to the correct selection and application of these conveyers in stock sizes. A chart showing the conveyability of various materials is included, together with dimensions and specifications of stock components.

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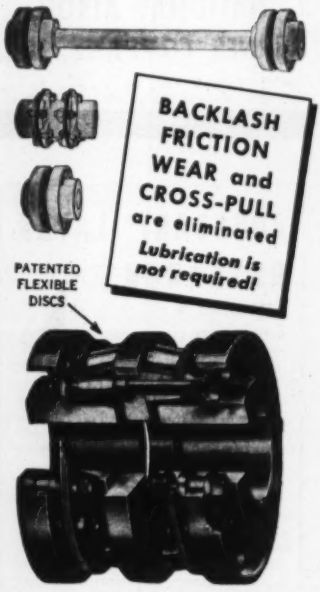

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ASME CATALOG

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Induction Heating

A 25-page bulletin on Ther-Monic induction heating facts, used exclusively by the field engineers of Induction Heating Corp., is now available to heads of departments of large metal working plants. Request should be made to Induction Heating Corp., Brooklyn, N. Y.

Metalworking Machines

A completely new 32-page catalog describing how Di-Acro metalworking machines perform a wide variety of forming, cutting, and punching operations in medium and lightweight materials is available from O'Neil Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn. Printed in two colors, a feature of the catalog is the arrangement of machine specifications and material forming capacities into tabular form for quick, ready reference by the reader. Additional features include photographic case histories of how numerous companies are applying "Die-less Duplicating" techniques to their particular problems, photos and descriptions of new and improved products, a listing of accessories, and complete information on both the Di-Arco Engineering Service Offer and the Di-Arco Warranty Agreement.

Electrical Computer

The Model 30-103 Electrical Computer, designed for rapid solution of as many as 12 simultaneous linear equations, is described in a new bulletin, No. CEC-1802A, issued by Consolidated Engineering Corp., Pasadena, Calif. The computer, applicable to many fields such as electrical circuit study, craft flutter analysis, and statistics, is fast and accurate, yet priced within the budget of the average laboratory. It has been used widely for rapid reduction of mass spectrometer and infrared spectrophotometer data. With circuits designed around simple, well-established electrical principles, the 30-103 Computer is stable and rugged, capable of maintaining consistent accuracy over long periods. Its operation is based on the iterative method of obtaining a series of increasingly accurate approximations.

Axivane Fans

"Axivane" Fans for cooling air-borne or ground-located electronic equipment are discussed in a new bulletin, J-612, now available from Joy Mfg. Co., Henry W. Oliver Building, Pittsburgh 22, Pa. The bulletin includes specifications on vane axial-type fans with diameters from 2 to 14 in.; capacities from 20 to 4400 cfm; weights from 10 oz to 52 lb; and horsepower from $^1/_{100}$ to 12 hp. Described fans are designed to meet such requirements as: spot cooling of local high-temperature conditions; heat removal from restricted space; and heat removal from pressurized or hermetically sealed units. Built of cast aluminum or magnesium for lightweight, the fans are said to operate effectively at high altitudes and at temperatures as low as −100 F. The entire fan unit is mounted inside the duct through which it is to force air, is direct-driven by the motor around which it is built. The fans are offered with either 27 volt d-c motors, or 60 and 400 cycle a-c motors. Designed to meet Air Force and Naval specifications, they can also be furnished with totally enclosed or explosionproof motors.

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Flexible Metal Hose

A 32-page illustrated catalog, No. CMH-130, on all types of Chicago Metal Hose has been released by Flexonics Corp. This catalog covers the full range of the company's manufacture in Rex-Weld corrugated flexible metal hose, Rex-Tube convoluted hose types, and Rex-Flex, stainless steel flexible metal hose. Complete specification data are given. Also covered are coupling types, special assemblies, and installation information. Copies available from Flexonics Corp., 1305 South Third Ave., Maywood, Ill.

Electric Radiant Panels

New Chromalox electric radiant panels are described in an illustrated 6-page bulletin just published by Edwin L. Wiegand Co., 7646 Thomas Blvd., Pittsburgh 8, Pa. The folder explains how this new infrared generator can be used for paint baking, curing, drying, degreasing, and other operations. The panels produce an unvarying radiation in a longer "far-infrared" wave length that is efficiently absorbed by all colors of material, with negligible reflection even from white surfaces. Built-in essentials like (1) fully insulated alloy infrared element, (2) 5-ply thermal insulation, (3) continuous 100-amp bus, and (4) its own structural steel frame, make it ideally suited to rapid infrared oven construction at lowest cost per kilowatt. Dimensions, ratings, and intensity controls are also listed. Ask for Bulletin CS-605.

Welding Steel Tubing

"How to Fabricate Welded Steel Tubing," is the title of a new 28-page manual published by Armco Steel Corp., Middletown, Ohio. The booklet consists of 10 major sections—Cutting, Deburring, Bending, Swaging, Special Tube-End Forming Machines, Punching and Notching, Drilling, Joining, Cleaning, and Finishing. Each subject is treated in a concise, practical manner, with special emphasis being given to "how to do it and what to do it with." The booklet is equally useful as a reference work to both experienced and inexperienced fabricators.

Magnetic Amplifiers

The first line of Magamp magnetic amplifiers produced by Westinghouse is described in a new 18-page booklet. Magnetic amplifiers are rapidly assuming an important role in systems which require reliable, static power amplification. With a high ratio of power amplification to response time, they assure improved control in a wide range of applications. In an early section of the booklet, a definition of magnetic amplifier terminology is given. This is followed by a careful explanation of the theory of operation. Curves, tables, and wiring diagrams are spread profusely throughout the sections which deal with component parts, applications and operating characteristics. For a copy of booklet, No. TD-52-600, write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Fastening Handbook

The new Southco Handbook of Fastening Specialties, catalog B-2, contains 22 pages of information on industrial fasteners for metal-to-metal and metal-to-wood applications. Blind Rivets and a variety of door latching and fastening devices are illustrated in this two-color, spiral-bound book which also includes several pages of frequently used engineering data. Installation procedure, sample applications, and complete dimensional information are given for all fasteners. Available from Southco Div., South Chester Corp., Lester, Pa.

Flexible Couplings

The Thomas Flexible Coupling Co., Warren, Pa., announces availability of its latest engineering catalog No. 51 describing its full line of all metal flexible couplings for power transmission. Couplings are grouped and indexed to facilitate quick reference. Keyway data, standards for straight and tapered bores, as well as ordering instructions are included for each group. Standard couplings are shown in individual sections of the catalog and are followed by a special section showing many couplings designed for specific purposes with photos of typical installations. A wide range of horsepower and speeds are covered from small motor couplings to large industrial applications and main drives on Diesel locomotives and ships.

SPRAY NOZZLES... two guides to proper selection!

No matter what you may face in the way of a spraying problem, it can be solved quickly and at low cost with Spraying Systems Spray Nozzles. Two fact-packed catalogs—No. 22, General Industrial Spray Nozzles, and No. 23, Pneumatic Atomizing Nozzles—are yours for the asking. They show you all the various types of spray nozzles available . . . explain design and construction . . . and outline spray characteristics such as atomization, impact of spray and capacity. Write for your copies today.

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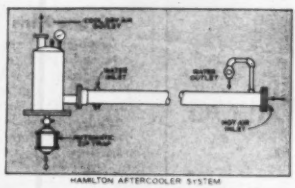
If you are up in the air about what to buy
Come down to earth where the air is dry.



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Moisture Elimination Up To 3000 Pounds Per Square Inch

Machine-Tool Conduit

A 2-page bulletin covering Chicago metal hose machine-tool conduit has been released by Flexonics Corp., 1305 South Third Ave., Maywood, Ill. This bulletin presents complete information on CMH machine-tool conduit and fittings, now finding wide usage on automotive plant machinery, chemical processing equipment, and in many other industries as well as on machine tools. The product was especially designed with durable steel core and tough Geon cover to protect electrical wiring from oil, moisture, fats, coolants, greases, and dirt.

Silicone Rubber

Designers, purchasing agents, and engineers will be interested in a new booklet on G-E silicone rubber just published by General Electric's Chemical Division, Pittsfield, Mass. Entitled "Imagineering With G-E Silicone Rubber," the 24-page bulletin No. CDS-3, includes comprehensive information on properties, applications, classes, and design specifications of G-E silicone rubber. The applications illustrated in the booklet clearly show how the unique properties of G-E silicone rubbber are helping to make better products, improve production processes and develop entirely new products. These properties include resistance to temperature extremes, release from sticking, inertness, and unusual surface properties.

Ingersoll-Rand History

Ingersoll-Rand has published a 36-page pocket-size booklet presenting a brief history of the company, its plants, and products and giving little known facts about the company. There are nearly 100 pictures showing Ingersoll-Rand's products at work. Some of them are: rock drilling; air and electric tools and hoists; air and gas compressors; gas and Diesel engines; centrifugal blowers; centrifugal and propeller pumps; vacuum and condensing equipment; and refrigerating units. For copies of this booklet, write Ingersoll-Rand, 11 Broadway, New York 4, N. Y., and ask for Form 300.

Pipe and Tubing

The design, fabrication, and application of equipment using stabilized stainless-steel tubing, is given in a new data card issued by the Tubular Products Div. of The Babcock & Wilcox Co., Beaver Falls, Pa. Known as bulletin TDC-144, it discusses B & W Croloy 18-8 Ti (AISI Type 321). Included are condensed data on corrosion resistance, creep strength, oxidation resistance, mechanical properties, machinability, welding characteristics, heat-treatment, and physical properties. Although popular in its own right, this steel recently has become more widely used due to the fact that the use of the columbium stabilized alloy, 18-8 Cb (AISI Type 347) has been restricted.

Dust Filter

A new bulletin, No. 102, describes in detail the new Sly Dynaclone dust filter. This filter was designed primarily for the continuous process industries where uniform suction at all dust points is essential. It gives complete engineering data on this equipment, including details of construction, principle, and application. Included in the bulletin are hints on the engineering of dust-control problems, as well as other useful engineering aids. A copy of the bulletin can be obtained from the W. W. Sly Mfg. Co., Cleveland 2, Ohio.

Alloy Castings

A new 48-page publication of interest to users and potential users of stainless and heat-resistant alloys in cast form is available from International Nickel Dept. EZ, New York 5, N. Y. Typical compositions regularly produced, with their applications, limitations and the types of service for which they are suitable are discussed. Over 175 photographs illustrate applications of typical alloys by industry. Charts compare creep strength of various alloys, resistance to corrosion in certain media, and to oxidation at elevated temperatures. Tables of composition list principal Alloy Casting Institute designations as well as certain proprietary alloys.

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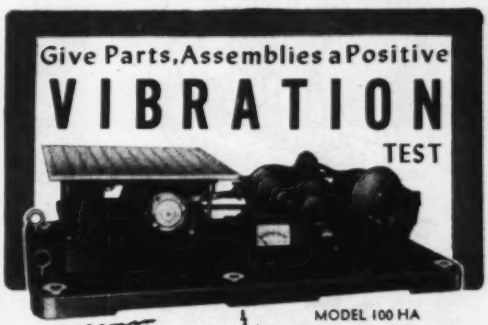

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Capacity 100 Lbs. Produces Vibrations horizontally. All controls in easy reach.

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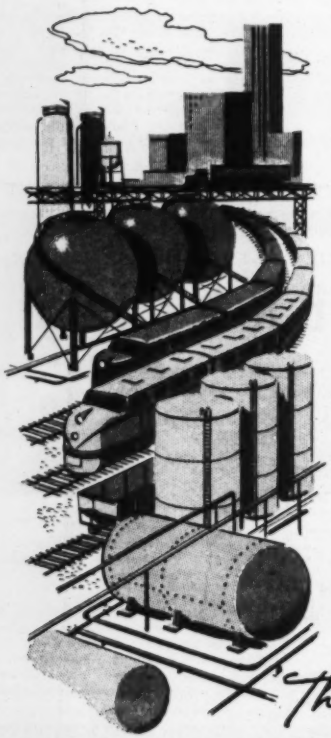
When you want to prevent corrosion under difficult conditions . . . to keep moisture vapor out of insulation . . . to control heat loss and rust with the same coating . . . to resurface leaking walls . . . you want a coating the durability of which has been unquestionably proven by industry. Here are five reasons **WHY YOU SHOULD *SPECIFY***

Superior INSUL-MASTIC *Coatings*



1. Insul-Mastic *superior* coatings provide extra long term protection. This is due to the superior ingredients from which they are manufactured and is attested to by Weather-O-Meter tests and actual field applications of many years duration.

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5. Insul-Mastic *superior* coatings contain an extremely high percentage of solids and thus, can generally be built up to their specified thickness in a single application . . . and, their shrinkage on drying is greatly minimized.

Think first of the coatings that last!

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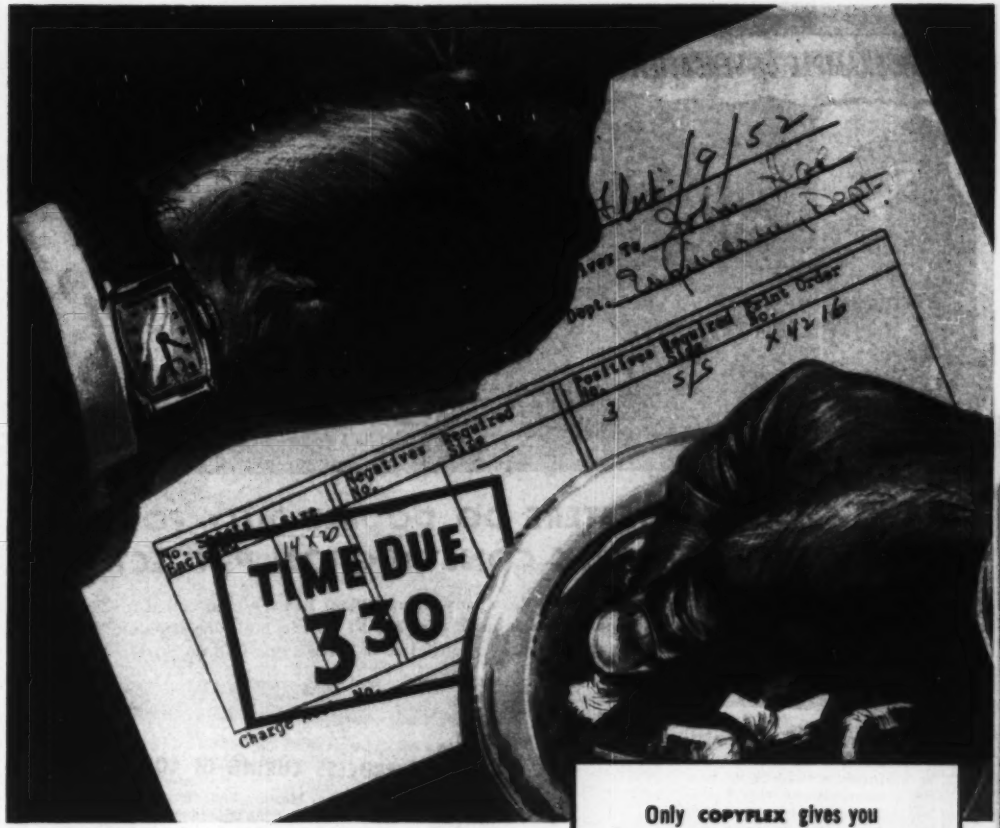

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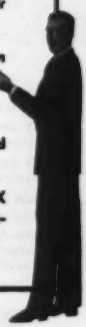

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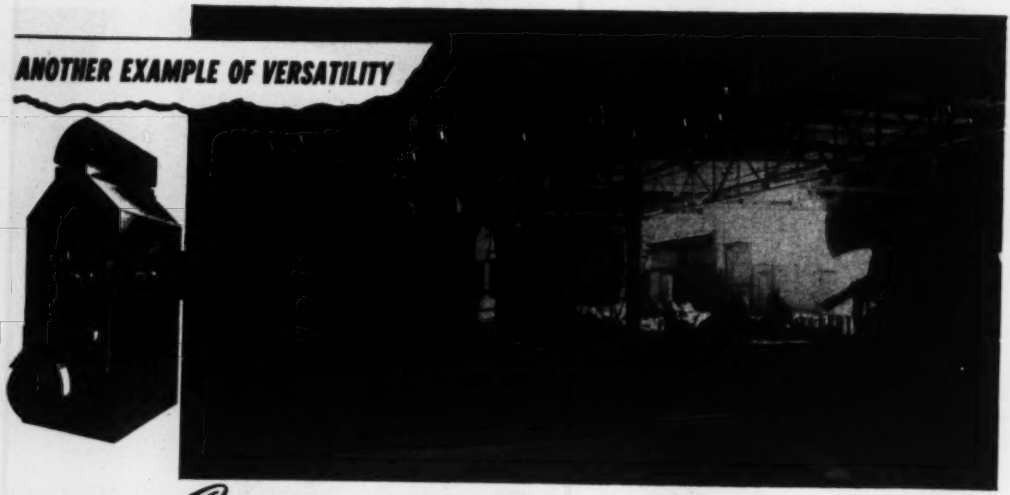

DRAVO *Counterflo* HEATERS DO DOUBLE-DUTY FOR FORD MOTOR COMPANY CONSTRUCTION PROJECT

Construction of the new Ford Motor Company Engine Plant in Cleveland called for temporary heating during the winter months of 1950-51 so the building schedule could be maintained. Six Dravo Heaters were installed to serve a two-fold purpose:

1. COMFORT HEATING—The Dravo Heaters maintained a 40° F. temperature inside a 405,000 sq. ft. area when outside temperatures were 0° F. . . . operated 24 hours per day . . . distributed and recirculated heat throughout the working area with a maximum air throw . . . eliminated the need for salamanders or bonfires to keep workers warm, thereby reducing fire hazards.

2. PROCESS CURING OF CONCRETE—The Dravo Heaters kept the ground from freezing so concrete could be poured during sub-freezing weather. Heaters helped cure concrete quickly . . . were easily moved to any location to fit job requirements.

DRAVO HEATERS OFFER YOU . . .

LOW INITIAL COST—users report 30% to 60% savings.
EASY INSTALLATION—fuel, electrical and exhaust connections are only requirements . . . no duct work.
LOW FUEL CONSUMPTION—burns gas or oil . . . readily converted . . . direct-fired.
QUICK HEAT—fast warm up . . . heat starts when heater is turned on.
LISTED-APPROVED—listed by Underwriters' Laboratories, Incorporated . . . approved by American Gas Association . . . acceptance by Factory Mutual Engineering Division of Dravo standardized safety control circuit.
AUTOMATIC CONTROLS—on-off or modulating controls.
MOBILITY—can easily be moved to any location to suit requirements.
FLEXIBILITY—can be mounted horizontally or vertically on ceiling, walls or floor.
LONG SERVICE LIFE—stainless steel combustion chamber eliminates refractory lining.

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SIMPLE DESIGN - RUGGED CONSTRUCTION

AUTOMATIC WEAR COMPENSATION THROUGHOUT MOTOR LIFE

HYDRAULIC BALANCE MEANS LONGER LIFE AND LESS MAINTENANCE

CONTINUOUS DUTY RATINGS TO 26 HP

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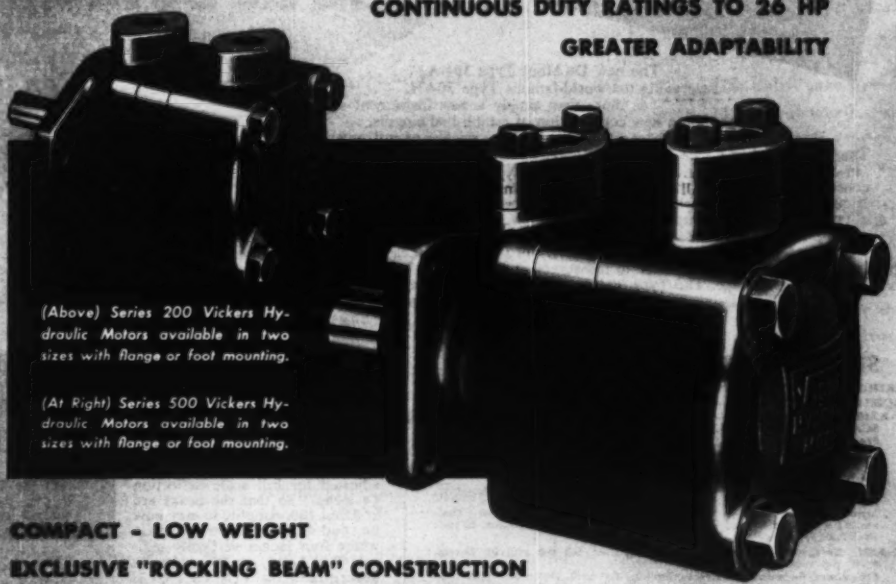

(Above) Series 200 Vickers Hydraulic Motors available in two sizes with flange or foot mounting.

(At Right) Series 500 Vickers Hydraulic Motors available in two sizes with flange or foot mounting.

COMPACT - LOW WEIGHT

EXCLUSIVE "ROCKING BEAM" CONSTRUCTION

DYNAMIC BALANCE AND QUIET OPERATION

COMPANIONS TO VICKERS BALANCED VANE TYPE PUMPS

Two series of Vickers Balanced Vane Type Hydraulic Motors are now in production. They offer many advantages for the economical and efficient application of variable speed rotary mechanical power to machine tools, industrial machinery and mobile equipment. Some of their important features are mentioned above; for further information get in touch with your nearest Vickers Application Engineering Office.

Write for NEW Bulletin M-5102

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the new DUMONT Type 304-A

The new Du Mont Type 304-A, succeeding the world-famous Type 304-H, is more than simply a new instrument – more than a new combination of established circuits. It represents a significant development in the science of instrumentation. The Type 304-A is *a true electronic voltmeter*. This reflects a new concept in oscillography. Every feature of the Type 304-A has been evaluated with this concept in mind. All of the features that made the Type 304-H so valuable as a qualitative instrument have been preserved and augmented to enable not only qualitative analyses, *but rapid, accurate quantitative amplitude measurement* as well. The novel amplitude calibrating system of the Type 304-A permits signal measurements from the screen *directly in volts*. Unlike electro-mechanical devices, the new Type 304-A is not restricted to measurement of sinusoidal signals – or peak-to-peak values of voltage. The Type 304-A may be used to measure any amplitude portion of signals within its performance specifications.

SPECIFICATIONS:

CATHODE-RAY TUBE – New Flat-Face Type 5ADP-
ACCELERATING POTENTIAL – 3000 volts.
Y-AXIS: *Deflection Factor* – Through amplifier, 0.1 p-p volts FULL SCALE (equivalent to 0.025 p-p volt/inch). Direct, 32-39 p-p volts/inch.
Frequency Response – Direct coupling: flat to 0. Down not more than 10% at 100,000 cps. Capacitive Coupling: down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps. Provision for balanced input on 0.1 VOLT-FULL-SCALE range.
Undistorted Deflection – More than 4 inches.
Expansion – Equivalent to 20 inches.
Input Impedance – *Amplifier:* (single ended) 2 megohms 50 $\mu\mu f$; (balanced) 2 megohms, 35 $\mu\mu f$. *Direct:* (single ended) 1.5 megohms, 20 $\mu\mu f$; (balanced) 3 megohms, 20 $\mu\mu f$.
X-AXIS: *Deflection Factor* – Through amplifier, 0.3 p-p volt/in. Direct, 40-50 p-p volt/in.
Frequency Response – Direct coupling: flat to 0. Down not more than 10% at 100,000 cps; down not more than 50% at 300,000 cps. Capacitive coupling: Down not more than 10% at 10 and 100,000 cps. Down not more than 50% at 300,000 cps.
Undistorted Deflection – More than 4 inches.
Expansion equivalent to 30 inches.
Input Impedance – *Amplifier:* 2.2 megohms, 50 $\mu\mu f$. *Direct:* (single ended) 1.5 megohms, 20 $\mu\mu f$; (balanced) 3 megohms, 20 $\mu\mu f$.
LINEAR SWEEPS: *Sweep Frequency* – Recurrent and driven sweeps continuously variable from 2 to 30,000 cps. Maximum sweep-writing-rate, 1"/μsec. Provision for sweeps of extra-long duration; ½ sec. of sweep obtained for each microfarad of external capacitance.
Synchronization – from signal of either polarity.
Sync Limiting – on both driven and recurrent sweeps.
VOLTAGE MEASUREMENT – Squarewave standard applied for calibration by front panel push button.
Voltage Range: VOLTS FULL SCALE, 0 to 0.1, 1, 10, 100 volts. MULTIPLIER: x1 to x10
Overall Accuracy: 5%
INTENSITY MODULATION – 15 volts blanks beam at normal intensity settings.
CALIBRATED SCALE – Variable illumination. Numbered calibrations for amplitude measurement.
PRIMARY POWER – 115 or 230 volts. 50-400 cps. 110 watts.
PHYSICAL CHARACTERISTICS – Metal cabinet with grey wrinkle finish. Dimensions: height 13½", width 8¼", depth 19½". Weight 50 lbs.

CALIBRATING the Type 304-A is as simple and easy as zeroing a vacuum-tube voltmeter. Depressing the CALIBRATOR push button on the front panel applies a square wave signal of precisely 0.1 p-p volt to the amplifier. The MULTIPLIER control is then adjusted for full scale deflection (4 inches) so that the peaks are at 0 and 100. Amplitude may now be read directly from the scale where four inches vertically indicate 0.1, 1, 10, or 100 volts, as determined by VOLTS FULL SCALE selector. Depressing the CALIBRATOR push button again, returns signal applied to Y-input terminals to the screen.

The MULTIPLIER control also permits calibration of the scale to other values. For, say, 200 volts-full-scale, the MULTIPLIER control is adjusted near 2 so peaks of squarewave are at zero and 50 on the scale. Amplitude may now be measured directly in volts simply by multiplying the scale reading by the setting of the MULTIPLIER control (2) and the VOLTS FULL SCALE setting (100). Use of the MULTIPLIER control extends the range of the Type 304-A to 1000 volts-full-scale.

DOMESTIC PRICE $333.00

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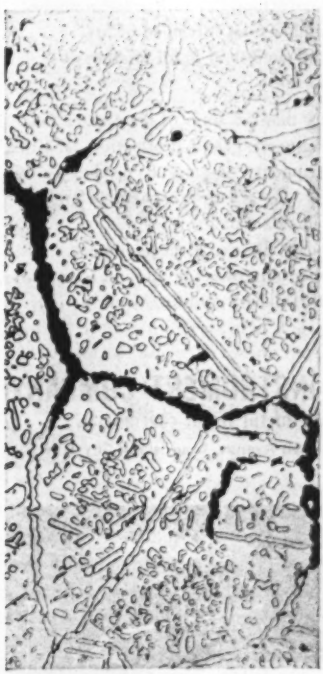
Inco High Temperature Research Note:

CARBURIZATION

...and its effect on metals at high temperatures

In chemical processing, petroleum refining, steam power generation and other work at high temperatures, metals are often exposed to atmospheres that may have unsuspected corrosive effects.

Common soot, itself, can seriously damage the usefulness of some heat-resisting alloys. When carbon diffuses into the grain boundaries, it embrittles the metal.



Under the microscope, this specimen reveals the reason why a carburizing box broke after 2200 hours of service at 1860° F. The thick black lines are the hard carbides which intruded along the grain boundaries and oxidized, causing embrittlement of the metal.

From INCO Research Laboratory, Case Report No. 5082.1.

This is one form of destruction that can be caused by carburization.

It may be a tolerable condition in some applications. Where the metal is subjected to impacts or sudden temperature changes, however, carburization can be the reason for premature failure.

The susceptibility of an alloy to damage by carburization seems to depend on the relative amounts of iron, chromium and nickel in the alloy. Nickel resists carburization. As a result, nickel-base alloys show excellent resistance to this form of high temperature corrosion.

There are some additions to this general observation:

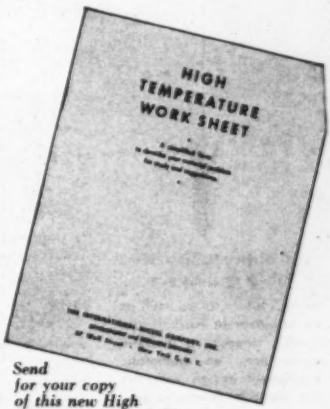
For example, high chromium steels with a ferritic structure do give good resistance to carbide formation. The practical limit on their usefulness, however, is the loss of strength they suffer at temperatures above 1300° F.

With exceptions like this in mind it is apparent why a considerable background of information is necessary to predict the performance of alloys at high temperatures.

That is why INCO'S metallurgists are continually investigating the behavior of alloys in the field and in research laboratories at Bayonne, N. J., and Huntington, West Va., to make more of this information available to industry through Inco's High Temperature Engineering Service.

Their creep and rupture tests at temperatures as high as 2100° F. supply data on the strength properties of high nickel alloys. Their studies of corrosive attack by various hot atmospheres, fused salts and molten metals provide the type of information that helps industry to select more suitable, longer-lasting materials for various high temperature applications.

When high temperature performance is a problem to you (or when you expect it to be), Inco High Temperature Engineers may have the answer for you. They have devised a special High Temperature Work Sheet on which you can set down your problem. Write for your copy now.



Send for your copy of this new High Temperature Work Sheet: it simplifies gathering the full story of your problem.

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We've been solving automatic control problems for 37 years

Controlling guided missiles in flight
Knowing your whereabouts under all circumstances
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Take one part of the fantastic, mix thoroughly with Ford's engineering and production ability, and you've got the answer to another "impossible" automatic control problem. That has been the sum and substance of the Ford Instrument Company since 1915.

Stabilizing a gun on a bouncing tank or a ship's plunging deck; governing the unique movement of a torpedo; keeping a pilot informed of his whereabouts at all times and in all weather — Ford found the answer!

From the more than 16 acres of floor space that make up the engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical and electronic instruments that bring us our "tomorrows" today! Research, development, design and production are being applied to control problems of both Industry and the Military.

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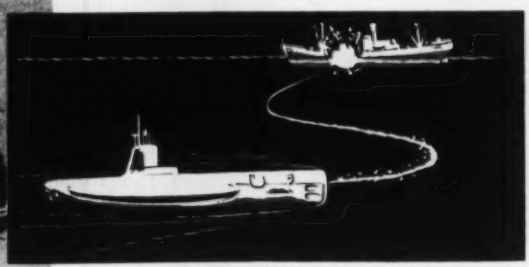
Build a future for yourself as an engineer at Ford. If you qualify there's a lifetime opportunity on automatic equipment design with the top name in automatic control. Write for our informative, illustrated brochure.



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no chance for gas or liquid leaks

with SYLPHON SHAFT SEALS!

You can count on a Sylphon Seal to "leak-proof" a rotating shaft—seal it against seepage of gases or liquids. And do the job as you want it done. For Sylphon Seals are designed and engineered on order, exactly to *your* specific requirements.

Pictured here are typical examples of Sylphon Seals. They can be made to withstand pressures up to hundreds of pounds. They reduce friction—save power—minimize shaft wear.

Uses are many—hydraulic transmissions, refrigeration or air compressors, speed reducers, pumps, washing machines and other units. Size range is wide. Write for helpful engineering service. Ask for Catalog TK-825.

Examining surface of Sylphon Seals by means of optical flats, to make sure surfaces are flat and smooth.

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● **High speed automatic packaging equipment makes possible the economical and safe distribution of many products from source to ultimate user.**

It is significant that on the finest types of specialized equipment of this kind made during the past half century, Diamond Roller Chains have been selected for constantly increasing numbers of applications.

Their precision and long-life dependability help materially in assuring trouble-free operating performance. Their flexibility of application helps simplify the machinery design. The cooperation of the Diamond Engineering Staff is available at all times.

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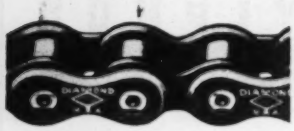
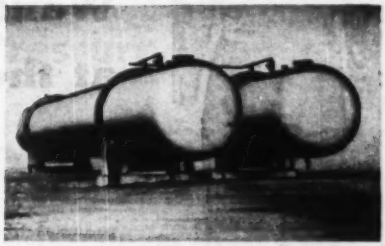
Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER



DIAMOND **ROLLER CHAINS**

100,000 GALLONS OF SAFETY



Posey Iron Works twin-tank installation for prominent public utility.

72" diameter headers for water intake lines fabricated throughout in our shops.

Alloy Steel Pipe awaiting shipment from the Posey Iron Works.

The Posey Iron tank illustrated provides 100,000 gallons of *safe* storage because forty-two years of experience went into its fabrication. And the real safety factor in any tank is the sum of its maker's experience . . . skill . . . facilities . . . and shop practices.

Here are a few of the advantages offered tank users by Posey Iron's knowledge . . . know-how . . . modernized plant . . . and sound practices:

1. Correct size and type of tank is determined by consultation with Posey Iron executives.
2. Posey Iron has the facilities to solve problems of *specialized* fabrication . . . design . . . or maintenance.
3. Posey Iron can help you determine the correct alloys when corrosive materials must be handled.

Talk over your steel plate requirements with the Posey Iron Works — where there is forty-two years of sound experience at your service.

- Tanks
- Stacks
- Digesters
- Pipe
- Pressure Vessels
- General Steel Plate Construction

Established Since 1910 — New York Office: Graybar Bldg.

POSEY IRON WORKS, INC.

LANCASTER, PENNSYLVANIA

DIVISIONS: BRICK MACHINERY, FOUNDRY, INDUSTRIAL HEATING, IROQUOIS, SHIPBUILDING, STEEL PLATE

Want a look at the overalls picture?

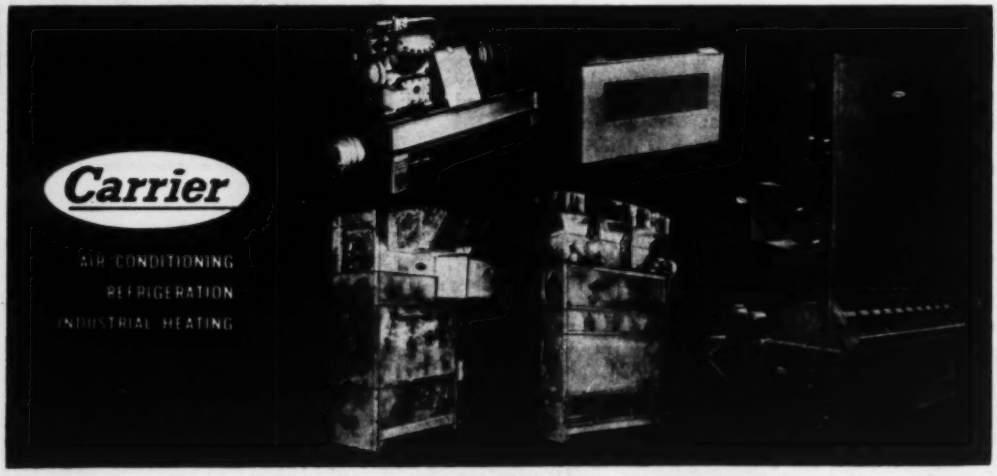
When we build the equipment you sell, we figure the Overalls Factor to be mighty important.

That's why there are always overalls in the Carrier picture. In all departments from drafting room to production line, there are men who have that certain "know-how" they got by working with equipment in a variety of applications.

It's only with their experience behind us that we can design and manufacture equipment that's going to do the job for your customers . . . that can be easily installed and serviced by you.

That's what makes the Carrier line so exceptional. It's a family of products built with you in mind . . . a family of products matched in size, performance and quality to put the most flexible air conditioning tools in your hands.

For instance . . . for small or medium size buildings there's a choice of systems to meet your needs. There's the Carrier low-pressure Weathermaster duct system with its volume control for individual rooms. And, for air conditioning the larger open spaces of multi-room buildings, such as meeting and assembly rooms, stores, restaurants and the like, there's the Carrier System and Zoning Weathermakers — each sectionalized to be fitted into your requirements for both comfort and industrial air conditioning. Carrier Corporation, Syracuse 1, New York.



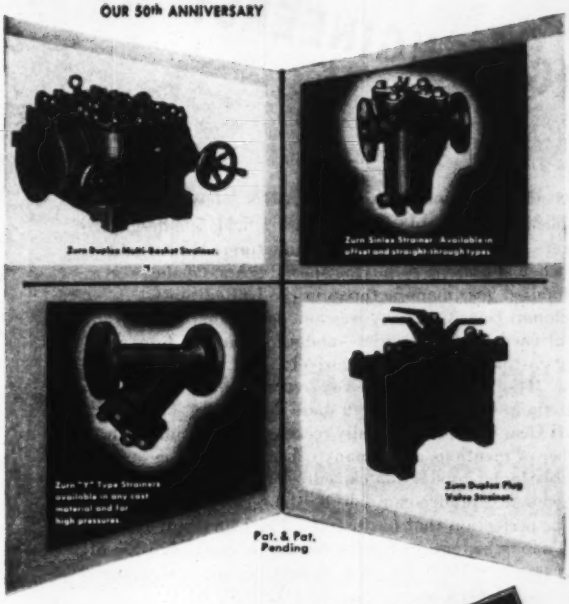
REFRIGERATING COMPRESSORS DUCT WEATHERMASTER SYSTEM WEATHERMAKERS
EVAPORATIVE CONDENSERS COLD DIFFUSERS ZONING WEATHERMAKERS

ENGINEERED

To Permit High Rates of Flow With Remarkably Low Pressure Drop

ZURN Low Pressure Drop STRAINERS

OUR 50th ANNIVERSARY

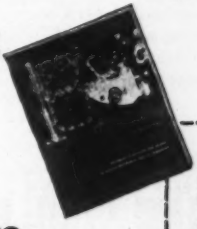

Zurn Duplex Multi-Basket Strainer.
Zurn Simplex Strainer. Available in offset and straight-through types.
Zurn "Y" Type Strainers available in any cast material and for high pressures.
Zurn Duplex Plug Valve Strainer.
Pat. & Pat. Pending

IMMEASURABLY IMPROVE THE HANDLING OF FLUIDS (OIL, CHEMICALS, WATER) THROUGH PIPE LINES

Now, a reduction of pressure loss can be obtained by the installation of Zurn Engineered Strainers. Design improved for correct circularity, smooth inner walls combined with correctly sized and perforated baskets reduce pressure loss and afford maximum protection for all types of mechanical units connected with pipe lines.

Zurn Strainers, are held to close manufacturing tolerances for materials, shape, and dimensions assuring the utmost in strength and safety. Zurn Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; municipal water systems; ships and high temperature, high pressure installations. Zurn Fluid Handling Engineers are available for consultation on your fluid handling problems.

Write for Pipe Line Strainer Manual No. 951, including previously unpublished pressure drop data.



J. A. ZURN MFG. CO.
INDUSTRIAL DIVISION • ERIE, PA., U. S. A.
In Canada: Canadian Zurn Engineering Ltd., Montreal, P. Q.

J. A. ZURN MFG. CO.
Industrial Division; Erie, Pa., U. S. A.
Please send me Pipe Line Strainer Manual No. 951

Name_____
Position_____
Company_____
Street_____
City_____ State_____
Please attach to your business letterhead—Dept. ME

Copyright 1952

CINTI

THANK YOU, DESIGN ENGINEERS!

Spur
Helical
Worm
Herringbone
Internal
**Coniflex Bevel*
Spiral Bevel
Spline Shaft

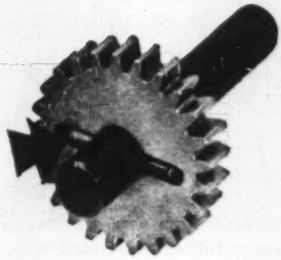
**Reg. U. S. Pat. Off.*

In a recent survey conducted by DESIGN NEWS Magazine, trade publication for the design-engineering field, 705 design engineers were asked to list the gear manufacturers they would consider when specifying or buying special gears. Of the several hundred gear manufacturers in the United States, The Cincinnati Gear Company was among the first *five* most often mentioned in all categories—and *second* among firms producing custom made gears exclusively. And when you realize that these "first five" firms received over 50 percent of *all* the mentions, the results become even more impressive. The Cincinnati Gear Company actually received many, many times the number of mentions given many other firms having considerably larger production capacities. Such popularity and industry-wide acceptance can only be the result of the constant striving for perfection that has marked The Cincinnati Gear Company's long history—a history of custom craftsmanship of quality gears since 1907. To those design engineers who named The Cincinnati Gear Company in the DESIGN NEWS survey—as well as in their orders and specifications—our thanks! And to those design engineers who are unfamiliar with our company or our product—we invite your inquiry.

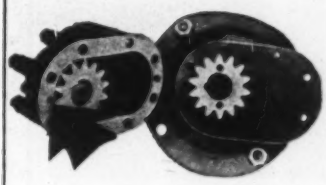
"Gears . . . Good Gears Only"

THE CINCINNATI GEAR COMPANY

Wooster Pike and Mariemont Ave. • Cincinnati 27, Ohio

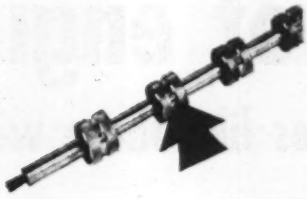


REPLACING A HUB ON A GEAR . . . Rollpin, self-retained in shaft, is simply snapped into molded slot to position sintered gear. This application, by Ditto Inc., effects major savings in assembly. Rollpin's high shear strength is particularly valuable here.



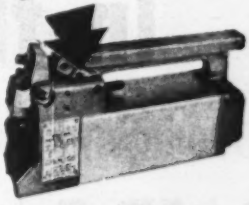
REPLACING A MACHINED PIN . . . In the lubrication pump assembly of the Cummins HR-400 diesel engine, two Rollpins are used as positioning dowels. Rollpins are self-retaining in production-drilled holes . . . quick to assemble and easy to remove.

REPLACING A HEADED PIN . . . In this hinge pin application, Rollpin is simply and inexpensively driven in place, greatly reducing assembly costs. Constant spring tension holds Rollpin firmly in place . . . eliminates loosening of hinge due to wear.



REPLACING A SET SCREW . . . Paper feed rollers are quickly, economically pinned to shaft by Rollpins in this office machine made by Ditto Inc. Flush fit affords neat appearance . . . spring tension assures positive, permanent positioning of rollers.

REPLACING A RIVET . . . Rollpin serves as guide shaft for spring-loaded electrical interlock contacts. The Square D Company reports that rivet failure previously occurred at the clinched end under normal operating impact and vibration.



REPLACING A BOLT AND NUT . . . Rollpins act as fasteners and pivots for the linkages in this Miller Electric Welder. Rollpins may be used with a free fit in outer or inside members depending upon product design requirements.

6 more examples of assembly-time saving with ROLLPIN

TRADE MARK

Rollpins are slotted, tubular steel, pressed-fit pins with chamfered ends. They drive easily into holes drilled to normal tolerances, compressing as driven. Reaming, tapering, extra assembly steps are eliminated. Rollpins are *locked* in place by the constant pressure they exert against hole walls. Inserted with an automatic press or by hand, Rollpins are readily removable with a drift or pin punch—and reusable again and again.

Elastic Stop Nuts with the famous red collar are another ESNA® product

FOR DESIGN INFORMATION—fill out and mail our coupon. If your plans include applications similar to those on this page—or clevis pins, keys, taper pins or stop pins—you can't afford to be without details on how much faster and cheaper Rollpin can do the job.

Dept. R6-1011 Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send me the following free information on ESNA self-locking fasteners:

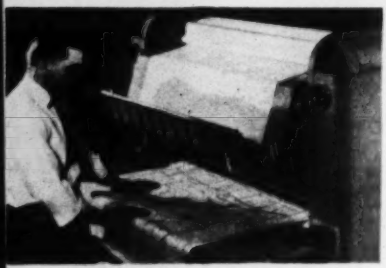
☐ Rollpin bulletin and sample Rollpins ☐ AN-ESNA conversion chart
☐ Elastic Stop Nut Bulletin ☐ Here is a drawing of our product. What fastener do you recommend?

Name_____ Title_____

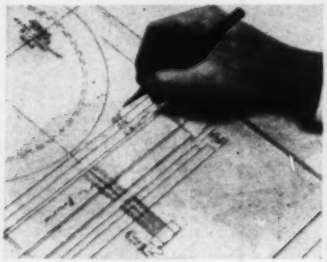
Firm_____

Street_____

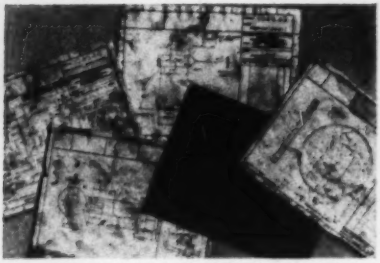
City_____ Zone_____ State_____



Photographic intermediates are produced without a negative step or darkroom handling with revolutionary Kodagraph Autopositive Papers, Cloth, Film. Simply expose in a blueprint or direct-process machine; develop in standard photographic solutions.



Low-cost insurance. By using Kodagraph Autopositive Paper intermediates for print production and reference work, valuable original drawings are protected against wear and tear. And this cuts redrafting costs.

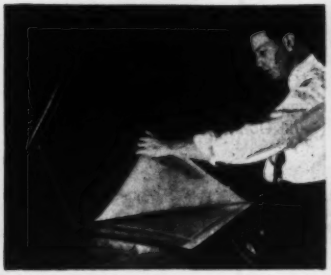


"Unprintables" reclaimed. Kodagraph Autopositive Paper drops out stains, creases . . . strengthens weak line detail . . . gives you intermediates with dense photographic black lines on a clean, evenly translucent base. *And sparkling subsequent prints.*

In thousands of engin

. . . . important advantages like these with

3 features combined in improved Kodagraph Reproduction Cloths. They produce intermediates which are *extremely durable . . . highly translucent . . . easy to correct.* Unwanted details can be removed with a pencil eraser; surface retains its tooth.



Time and dollars are saved in making contact photocopies with Kodagraph Contact Papers and Cloth because of their latitude and uniformity. Sparkling results are obtained without split-second timing . . . trial-and-error testing.

No deterioration in the files. Kodagraph intermediates are "photo-lasting" in the files . . . will not fade or become brittle . . . can always be counted on to produce sharp and clear blueprints or direct-process prints as needed.

Know the complete Kodagraph line—save dollars every day!

For use in your blueprint or direct-process machine . . . or vacuum frame.

● **Kodagraph Autopositive Paper Extra Thin** . . . the low-cost photographic intermediate paper for all-purpose use.

● **Kodagraph Autopositive Paper Translucent** . . . more translucent, faster "print-back" speed.

● **Kodagraph Autopositive Cloth** . . . for extremely durable, highly translucent photographic intermediates.

● **Kodagraph Autopositive Film** . . . for highest quality intermediates, very fast print-back speeds.

● **Kodagraph Repro-Negative Paper** . . . for positive intermediates *directly* from negative prints.

For use in your contact photocopy machine

● **Kodagraph Contact Paper Standard** . . . for general reference prints.

● **Kodagraph Contact Paper Extra Thin** . . . for translucent intermediates.

● **Kodagraph Contact Fine-Line Paper** . . . for extra-sharp, crisp photocopies of fine detail, printed halftones, poor drawings.

● **Kodagraph Contact Cloth** . . . for durable, highly translucent intermediates.

For use in your enlarging equipment

● **Kodagraph Fast Projection Paper** . . . for faster printing under low illumination.

● **Kodagraph Projection Paper** . . . for printing under comparatively bright workroom light.

(Both available in variety of stocks for every need.)

● **Kodagraph Projection Cloth** . . . for extremely durable, highly translucent intermediates.

For Microfilming

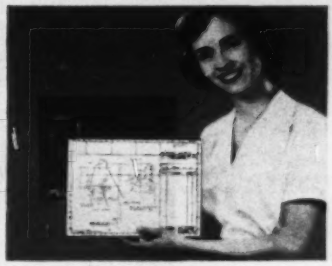
Kodagraph Micro-File Machines, Film Readers, Enlarger, Micro-File and Print Film.

4 Valuable Booklets Now Available

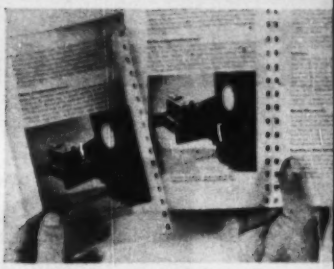
Free . . . "Kodagraph Micro-File Equipment" . . . full details on the versatile line of microfilming equipment which is designed for plants of every size.

Free . . . "Modern Drawing and Document Reproduction" gives details on complete line of Kodagraph Reproduction Materials, which you or your local blueprinter can process quickly and economically.

Plant layout speeded. Paper cutouts of machines, equipment, etc., are pasted in position on a print of the proposed layout, to which new detail is then added. From this opaque original, a printing "master" is produced on Kodagraph Autopositive Paper.



Positive copies of blueprints are no longer a problem. You can get fast-printing, positive photographic intermediates *directly* from blueprints or other negative prints with Kodagraph Repro-Negative Paper—another "roomlight" material.



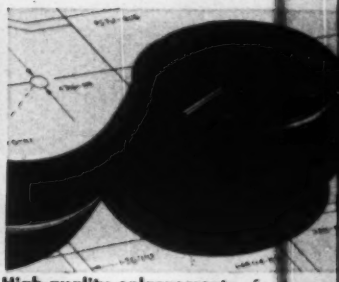
Printed half-tone and line illustrations reproduced at low cost. Just print on high-contrast Kodagraph Autopositive Film . . . and you have a "master" that includes every detail . . . and w turn out quantity prints at top spee.

eering departments

Kodagraph Reproduction Materials and Equipment

Protection is increased . . . filing space cut 98% with Kodagraph Micro-File Machines, designed for engineering departments of every size. Drawings and documents are recorded on Kodagraph Micro-File Film instantaneously . . . for a fraction of a cent apiece.

Fast, convenient film reference. Kodagraph Film Readers enable you to view your film records at ideal enlargement size . . . see every detail sharp and clear. And you can locate any record on the film roll in a matter of seconds.



High-quality enlargements of micro-film or other reduced-scale negatives are obtained with Kodagraph Projection Papers and Cloth, created for use with enlargers, projection printers, process cameras.

Free . . . "New Short Cuts and Savings". . . . interesting case histories show how industrial plants of every size are saving with Kodagraph Autopositive Paper.

Kodagraph Data Book — Price, 50 cents . . . 72 pages of helpful, detailed information about Kodagraph Products; recommendations for exposure, processing, storage. How to get best results with different types of equipment.

MAIL COUPON TODAY

16

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, New York

Gentlemen: Please send me free copies of

☐ "New Short Cuts and Savings" ☐ "Modern Drawing and Document Reproduction" ☐ "Kodagraph Micro-File Equipment."

☐ And a copy of the Kodagraph Data Book . . . 50 cents enclosed.

Name _____ Position _____

Company _____

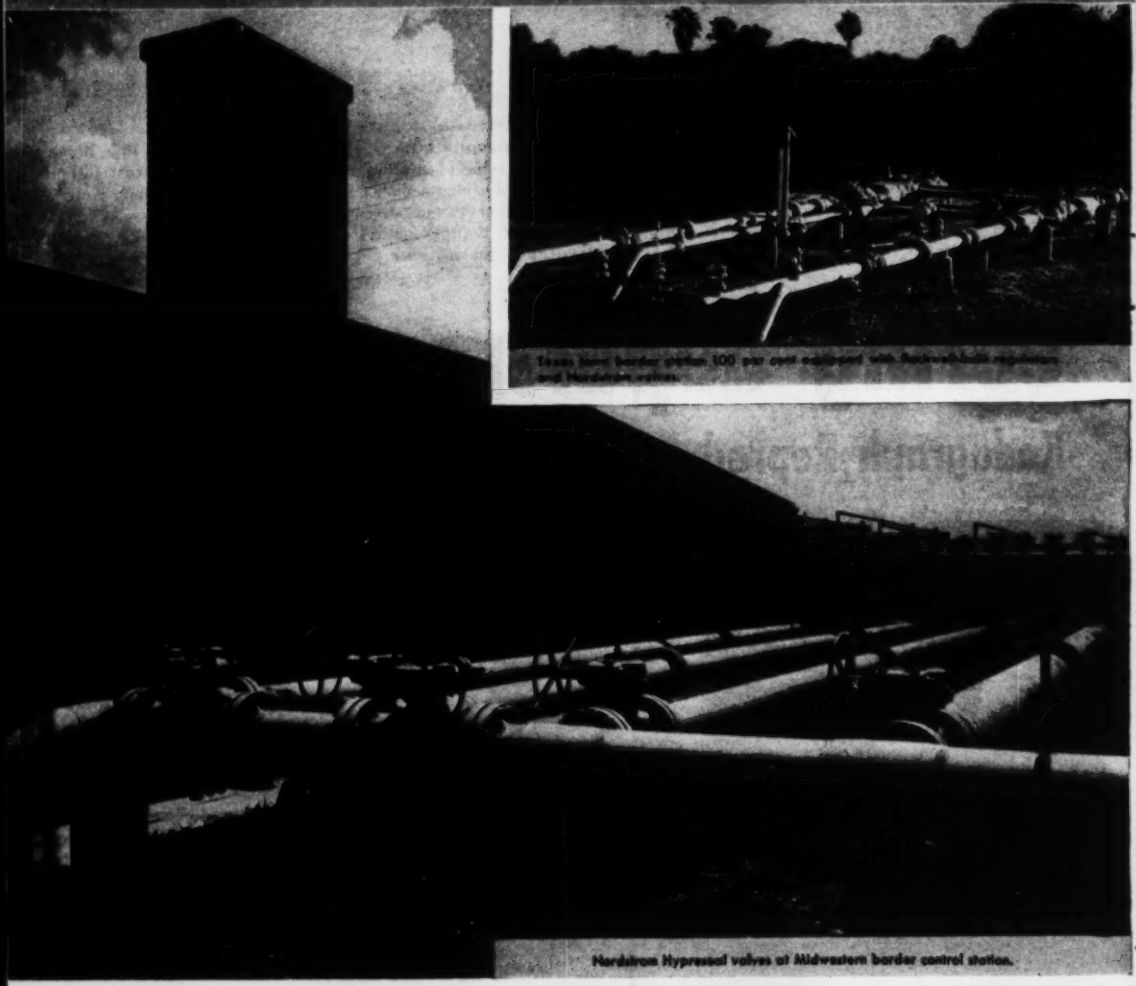
Street _____

City _____ State _____

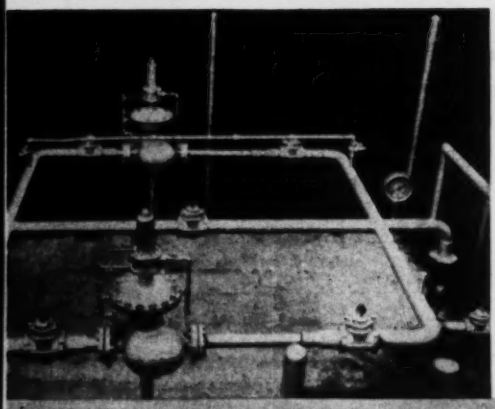
Kodak
TRADE-MARK

Town Border and Regulating

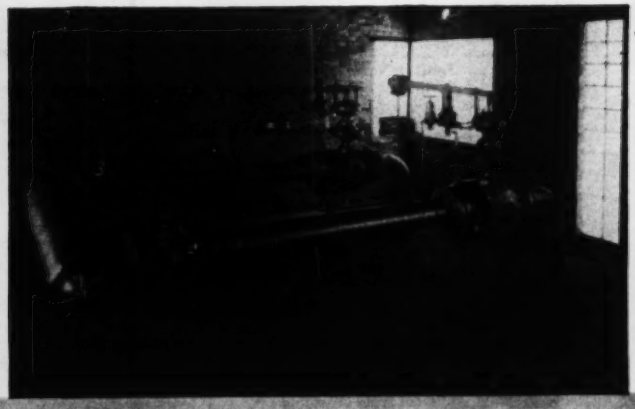
Town [illegible] border station 100 per cent equipped with Rockwell-Nordstrom regulators and Nordstrom valves.



Nordstrom Hypressed valves at Midwestern border control station.



Nordstrom valves and Rockwell regulators in Illinois Station.



Southern town border station—another 100 per cent Rockwell-Nordstrom valve and meter installation.

Stations . . . Another Gas Service Where

Spur-gear and wrench-operated Nordstrom valves at West Coast station.

Nordstrom Valves Excel

Town Border control and regulating stations differ in design, but regardless of local conditions there's a Rockwell-built Nordstrom valve for every service, pressure and piping arrangement.

From gas well through transmission and distribution lines to consumer, lubricant-sealed Nordstroms with self-energizing Hypermatic lubricant mean sure, trouble-free, low cost control at every step.

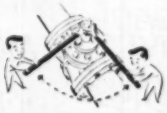
Here's Why Nordstrom Valves Are Best For All Gas Services

1. LUBRICANT SEALED

Nordstrom's internal lubrication system spreads a film of plastic lubricant around seats to prevent leakage, protect seating surfaces against line gases, and insure easy operation.

2. OPEN OR CLOSE WITH A QUARTER TURN

Turn a Nordstrom 90 degrees and it's completely closed. There's no guesswork. In an emergency, a Nordstrom closes in about one-tenth the time of an ordinary valve.

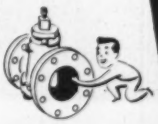


3. HYPERMATIC SELF-LUBRICATION

Exclusive Nordstrom Hypermatic lubricant stores its own energy to maintain constant lubrication indefinitely, keeping ports sealed and plug hydraulically lubricated for easy turning.

4. STREAMLINED FLOW PASSAGES

There are no recesses or crevices in which sediment might build up and no pressure-robbing cavities.



5. REPACKABLE UNDER PRESSURE

The Nordstrom Hypreseal valve can be safely repacked under any pressure or in any position. This feature eliminates costly facility shut downs.

6. MOST COMPACT

You save space and weight with compact Nordstrom valves. No protruding stems, yokes or bonnets, no exposed threads to corrode, no deep underhanging body. Nordstrom valves need little more space than the line flanges.

Write for Nordstrom valve literature to Rockwell Manufacturing Company, 400 N. Lexington Ave., Pittsburgh 8, Pa.

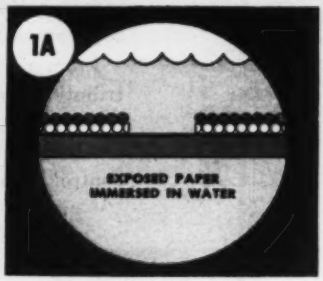
Rockwell Built Nordstrom Valves

Another Rockwell Product

Lubricant Sealed to Keep Upkeep Down

Why is a blueprint

Simplified diagram of enlarged cross section of blueprint paper shows surface particles of the coating being struck by light. The coating, which is pale in color, contains two soluble ferric salts: a cyanide complex and an organic acid. Light reduces some of the ferric to ferrous ions in the exposed areas, producing a mixture of both. Opaque lines in a superimposed drawing prevent the light from reaching the coating beneath, as shown by the black bar in the center.



In the presence of water, the ferrous ions in the exposed areas react with the cyanide complex to form a ferrous-ferricyanide, which is Prussian Blue. (This is the famous blue pigment, insoluble in water, discovered in Berlin in 1704.) The areas that were shielded from light contain only the original soluble salts. These are washed away by the water, exposing the white paper beneath. The print then has white lines on a blue background.

Contrary to ordinary photographic processes, moderate overexposure of a blueprint has two good effects. It permits light to penetrate beneath the surface of the coating and thus to act in depth. It also reduces more of the surface salts from the ferric to ferrous condition, including the cyanide complex. But carried to an extreme, overexposure causes light to penetrate the opaque lines of a drawing with a resultant loss of contrast in the developed print.

BLUE?

When a moderately overexposed print is immersed in water, the ion mixtures react together. However, the colorless ferrous compounds that are formed on the surface of the coating cover up the layers beneath, and tend to hide the Prussian Blue color which has formed in the bottom layers. The print, at this stage, will have a grayish cast without full contrast.

Nearly every blueprinter, after washing the prints, immerses them in a solution of potassium dichromate, or peroxide. These are oxidizing agents that reverse the effect of too much light, changing a proportion of the ferrous ions back to ferric ions. In this way, with the help of overexposure, the entire thickness of the coating can be made effective in forming Prussian Blue. A deep, rich blue, contrasty print results.

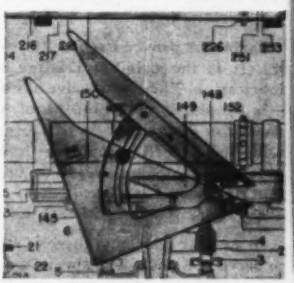
● As one of the oldest reproduction processes, blueprinting has undergone little development until recent years. CHALLENGE* blueprint papers embody every valuable advance made in this time and, in addition, are produced with the extra skill and care that go into all K&E products. The presence of more colloidal Prussian Blue, plus a pre-coating process, enable CHALLENGE papers to provide more vivid white lines against a background of deeper, more intense blue.

Other outstanding K&E reproduction materials include HELIOS† dry developing diazo papers, cloths and films; ONYX* moist developing diazo papers; MADURO† brownprint papers and cloths; DUPRO† reproduction tracing cloth; and PHOTACT† reproduction papers, cloths and films. Ask your K&E Distributor or Branch for full information on what these various K&E reproduction materials can do for you.

*Trade Mark †Trade Mark®

The Right Angle

For new ease in measuring straight, curved or irregular lines on maps, plans and charts use one of these precision built Plan and Map Measures. You can take off quantities with them and, with the models calibrated to ¼" or ⅛" scale, you can read distances directly in feet. Instantly re-set to zero by pressing the stem.



A triangle that gives you a straight edge that can be set at any angle! The TRI-TRACTOR*, basically a right triangle, also has a protractor element calibrated in half degrees. Its hypotenuse can be fixed at any desired angle with respect to the base line. Made of transparent plastic. Comes with 8" or 10" base.

K+E

Williams' Titan Crusher served by custom-built Farval centralized system

THE lubrication problem was this: How to keep the rotating spindle bearings on the novel crusher (at right) working dependably and efficiently in an important ore preparation plant.

The plant engineers knew that pulverizing and crushing stubborn flint-like ore creates tremendous bearing pressures and that meant that constant lubrication care was a must. They also knew that getting a lubrication system onto a rotating portion of a machine had always presented a ticklish problem. Yet, to stop the machine for guess-and-by-gosh hand oiling meant production hours wasted and, at best, a hit-or-miss lubrication job.

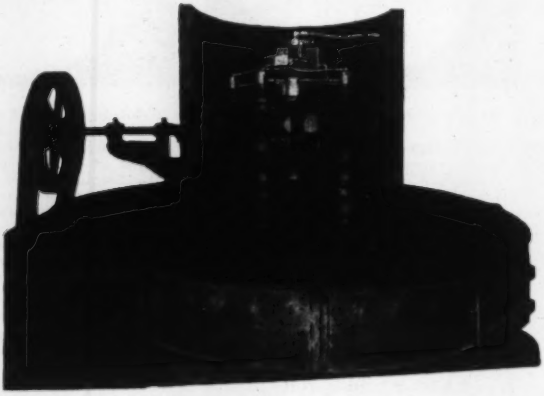
To cope with the special problems presented by this ore crusher, Farval engineers were called in and soon came up with a modern custom-built solution for lubricating constantly moving bearings. In a unique rotating connection and by means of tough, flexible hoses and a reversing element, the Farval Centralized Lubrication System was tailored to body-fit the gyrating portions of the crusher. This practical approach to machine preventive maintenance saves time and men, saves lubrication (as high as 75%) and most important, increases production.

Farval has proven itself in 25 years of service to industry. It is the original Dualine system of centralized lubrication. The Farval valve has only two moving parts —is simple, sure and foolproof, without springs, ball-checks or pinhole ports to cause trouble. Through its wide valve ports and full hydraulic operation, Farval unfailingly delivers grease or oil to each bearing—as much as you want—as often as desired. Indicators at every bearing show that each valve has functioned.

In or near your city, there is a Farval engineer ready to serve you with your special or conventional lubrication problems. Write now for Bulletin 25 and a full description of the Farval system at work. The Farval Corporation, 3264 E. 80th St., Cleveland 4, Ohio.

Affiliate of The Cleveland Worm and Gear Company, Industrial Worm Gearing. In Canada: Peacock Bros. Ltd.

FARVAL—*Studies in Centralized Lubrication* No. 135



KEYS TO ADEQUATE LUBRICATION—*Whenever you see the sign of Farval—the familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated. Farval manually operated and automatic systems protect millions of industrial bearings.*

Illustration by courtesy of Williams Patent Crusher and Pulverizer Co.

Would you like to receive each issue of this NEW Publication?

FARREL-BIRMINGHAM
FARREL GEARS PROVIDE TWO SPEEDS FOR COAL MINE HOIST
FARREL-BIRMINGHAM
FARREL PROPULSION GEARS FOR TWO MORE MORAN TUGS

Here is a new, four-page publication which tells of the latest developments in the design and application of gears, speed reducers, speed increasers and marine propulsion gearing. It is written for men in charge of the purchase, specification, maintenance or operation of this type of equipment.

The first and second issues are now available for distribution. Future issues will appear as we gather material of sufficient interest to warrant publication. We have no set publication schedule.

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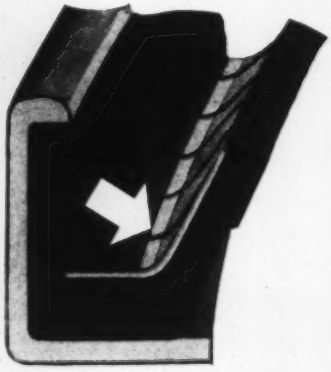
with FINGER SPRINGS or GARTER SPRINGS FOR EVERY BEARING APPLICATION

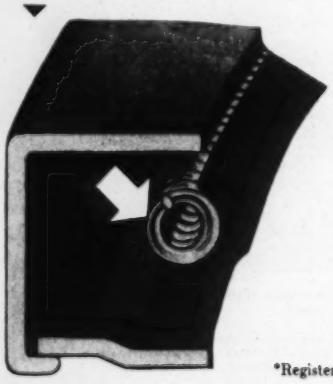


***Right:* FINGER SPRING**

The finger spring, perfected by Garlock, is very flexible. Each finger delivers independently a light yet active pressure to the lip of the sealing member. The result is a constant and responsive shaft-contact around the entire periphery of the sealing lip.

***Below:* GARTER SPRING**

The conventional type spring used in many types of oil seals. This spring is available in several KLOZURE models in which are also incorporated the same accurately molded synthetic rubber sealing member and precision-formed metal case that are used in all Garlock KLOZURE models.



*Registered Trademark

USE GARLOCK KLOZURES

There's a service-tested KLOZURE model with your choice of spring for every bearing application. These superior oil seals are produced in a wide range of sizes including Metric to fit standard International millimeter ball and roller bearing housings. Prolong the life of your bearings—*protect* them with Garlock KLOZURE Oil Seals.

Write today for Klozure Catalog No. 10.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS

Here is an easy equation—
HAGAN Ring Balance Meters = Dependability

WITH Hagan Ring Balance Meters you get accurate flow integration on oxygen, water, steam, gas, oil or other fluids. You get a meter that is rugged and sturdy, but still a precision instrument throughout. Design is simple and maintenance costs are low.

HAGAN RING BALANCE FLOW METERS are the most versatile meters available. A single meter unit can indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available which are capable of measuring differentials from 1" to 420" water column maximum and for static pressures ranging up to 15,000 psig.

For more information on how dependable Hagan Ring Balance Flow Meters can answer your metering problems, clip the coupon, or write, wire or call Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

Features of every HAGAN Ring Balance Meter include:

- **Ease of dead weight calibration**
- **No stuffing boxes**
- **Adjustable, full scale range**
- **Mercury level not critical**
- **High sensitivity at low flow rates**

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ME-10

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BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AERONAUTICAL
AND AUTOMOTIVE TESTING FACILITIES

Simplify Valve Inventories!

These "RENEWO" Valves Convert From Fullway To Plug Type!

Lunkenheimer "Renewo" Valves feature renewable and regrindable seats and discs . . . convertible from fullway to plug type. Stockroom investment and maintenance expense can be cut substantially by users who standardize on the line for all their 200-lb. bronze globe valve needs. A similar line is also available in the 300-lb. class.

"Renewo" Valves can be reground, renewed, or converted easily.

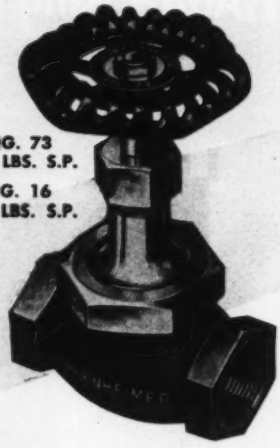


FIG. 73
200 LBS. S.P.

FIG. 16
300 LBS. S.P.

(FULLWAY TYPE) Seats and discs of hard, wear-resistant nickel alloy. Excellent for general service applications. One of the most popular valves ever designed.

FIG. 73 PS
200 LBS. S.P.

FIG. 16 PS
300 LBS. S.P.

(PLUG TYPE) Seats and discs of 500 Brinell Stainless Steel. Superior for severe erosive applications. Maximum resistance to effects of close throttling.

WRITE FOR Circular 577, which describes the "Renewo" line in detail. The Lunkenheimer Co., Box 360E Cincinnati 14, Ohio.

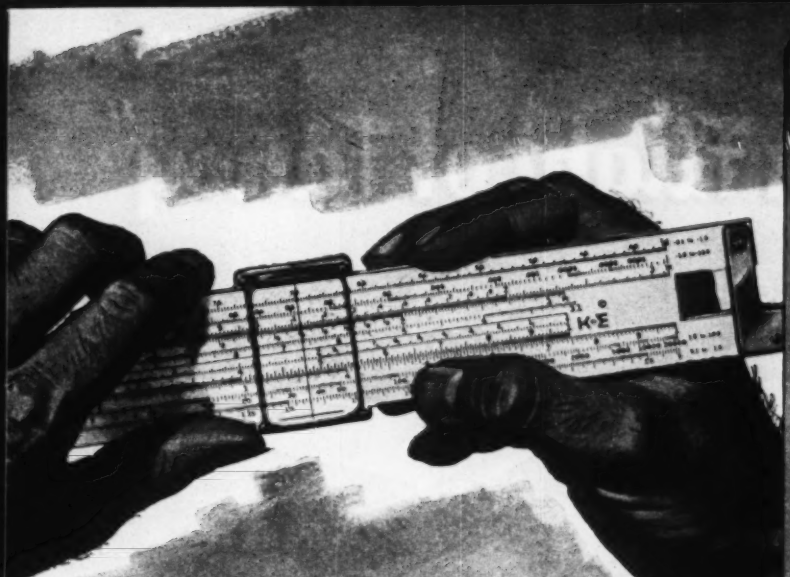
BRONZE • IRON • STEEL

See our exhibit, Booth 52 at the 20th National Power Show, Grand Central Palace, N. Y. . . . December 1 to 6, 1952.

LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

L-952-5



FAIRBANKS-MORSE DIESELS
CAN HELP SOLVE YOUR

Power Equation

Balancing the many elements of power requirements—against cost—is a major problem facing all manufacturers today. Failure to solve this complex equation can mean the difference between profit and loss.

But, is there a solution in *Your Plant*?

Look at this partial list of Fairbanks-Morse Diesel advantages and see. F-M in-plant power economically adds to current capacity as load increases . . . eliminates purchasing power at rates based on high peak demand values. Improved power factor. Better current characteristics. Flexibility. Economy. These are a few of the factors that can put your power equation in balance.

If you want the answer to your power equation, write us today outlining your needs. Fairbanks-Morse engineering can give you a proved answer . . . based on over 50 years' experience in industrial and municipal power generation. Fairbanks, Morse & Co., Chicago 5, Ill.

FAIRBANKS-MORSE

a name worth remembering when you want the best

DIESEL AND DUAL FUEL ENGINES • DIESEL LOCOMOTIVES • ELECTRICAL MACHINERY • PUMPS • SCALES • RAIL CARS • MAGNETOS • FARM MACHINERY

Put Your Power Costs and Performance in Order

1 *Handle Peak Demand* . . . reduce peak demand values for lower power and power cost.

2 *Raise Power Factor* . . . "in-plant" generator can eliminate power factor penalties.

3 *Emergency Power* . . . insurance against lost production, damage due to line failures.

4 *Handle Surge Loads* . . . that may now be affecting current characteristics of entire plant.

5 *Plant Expansion* . . . need not be restricted due to lack—or expense—of ample power.

6 *Useful Heat* . . . lube oil, water and exhaust heat can cut drying and heating costs.

7 *Chemical Value* . . . exhaust gases are high in nitrogen—available for economical fixation of nitrates, ammonia.

8 *Insurance Advantage* . . . of diesel over gasoline engine, for example, will soon pay for installation.

9 *No Weather Worries* . . . ice, snow, sleet, wind storms can't stop plant operations.

10 *Handle Increasing Load* . . . "in-plant" power economically adds to current capacity as load increases.

11 *Fuel Economy* . . . use diesel oil, natural gas or sewage gas for added economy.

12 *Remote Locations* . . . distance from transmission lines needn't curtail planned plant expansions.

13 *Compact Power* . . . Fairbanks-Morse engines give you more power per foot of floor space, more power on present foundation.

14 *Minimum Attendance* . . . Fairbanks-Morse "in-plant" generating sets require minimum supervision and maintenance.

15 *Save Cost* . . . of running in new line where present transformers and power lines are already loaded.

"Not A Flight of Fancy"

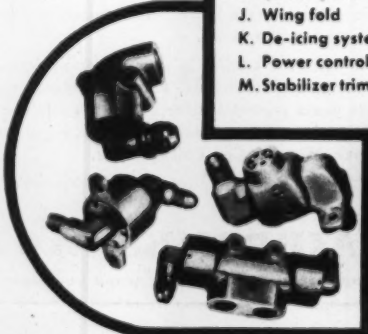
HERE ARE WAYS CHIKSAN CAN HELP AIRFRAME MANUFACTURERS

The airplane shown here is not an actual picture of any one plane. Rather, it is a composite to show some of the varied ways in which Chiksan planning can help the airframe manufacturer do a better job.

Fuel, oil, water, air and oxygen all find dependable, safe, uninterrupted flow through Chiksan aero-hydraulic swivel joints and assemblies.

CHECK THESE APPLICATIONS IN YOUR BLUEPRINTS:

- A. Refueling boom assembly
- B. Steering control mechanism
- C. Brake system
- D. Spoiler actuating mechanism
- E. Fuel and oil lines
- F. Adjustable sweep-back system
- G. Emergency dump chute
- H. Flap actuating system
- I. Power-plant fuel and oil lines
- J. Wing fold
- K. De-icing system
- L. Power control system
- M. Stabilizer trim



A few of the many Chiksan aero-hydraulic swivel joints made for pressures ranging from 1000 to 3000 psi.

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints

REPRESENTATIVES IN PRINCIPAL CITIES

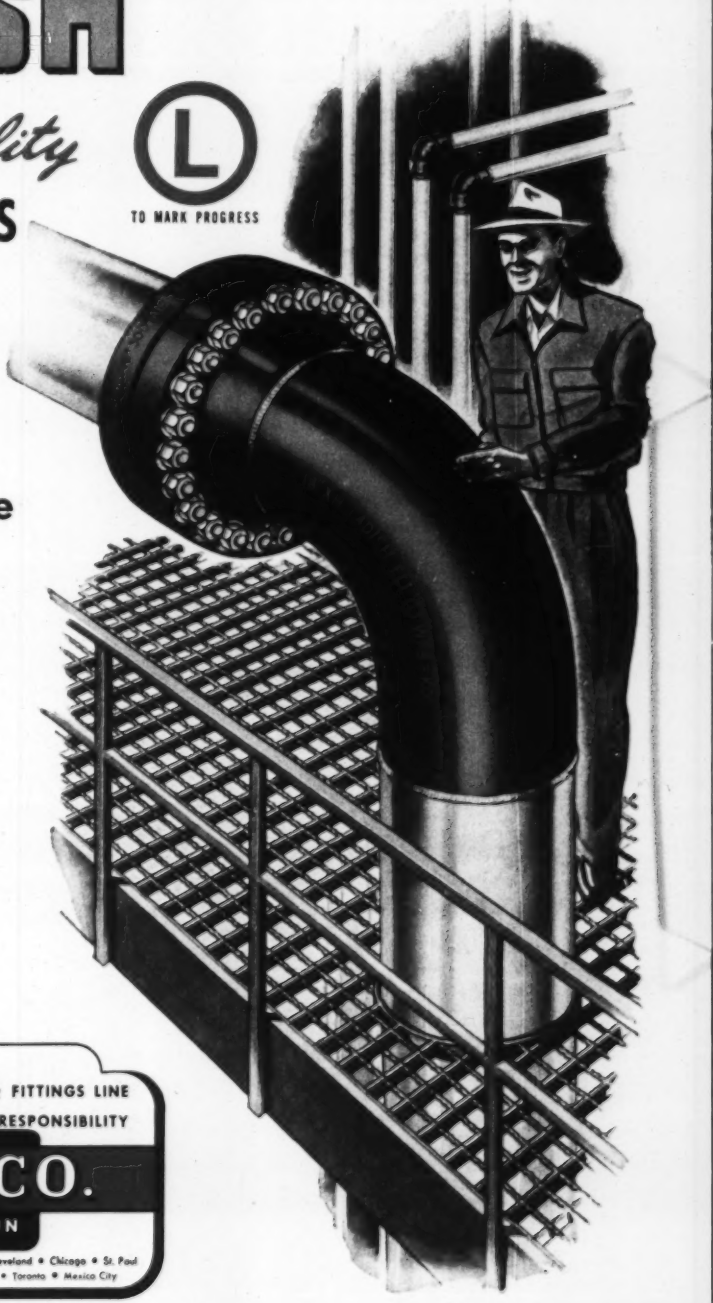
CHIKSAN

LADISH

Controlled Quality

PIPE FITTINGS

TO MARK PROGRESS



metallurgically sound for maximum service

Sound metallurgy . . . the result of unsurpassed facilities and advanced laboratory controls . . . provides the maximum of dependability in Ladish Controlled Quality fittings. Every phase of metal quality . . . composition, structure and physical properties . . . is continuously safeguarded—and certified proof of metallurgical integrity is available to users of Ladish fittings.

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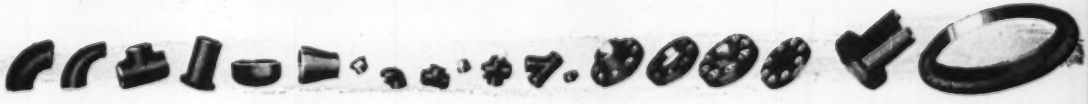
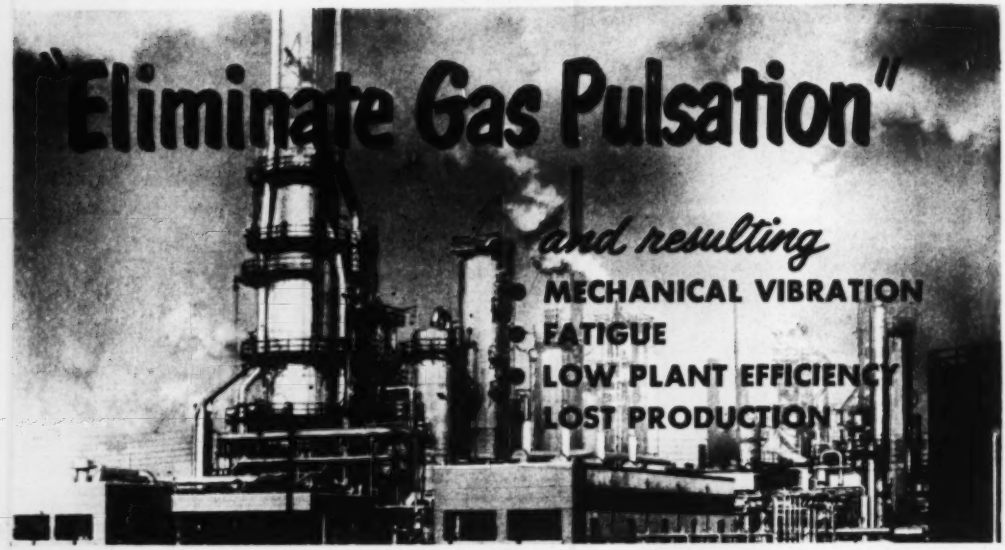
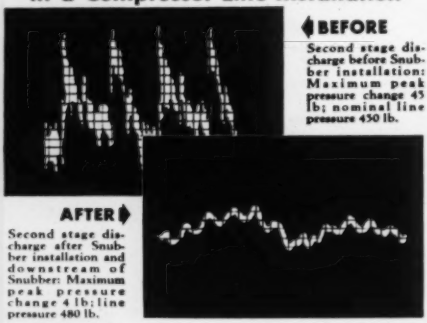




Solution to a typical Surge Problem in a Compressor Line Installation



BEFORE

Second stage discharge before Snubber installation: Maximum peak pressure change 45 lb; nominal line pressure 450 lb.

AFTER

Second stage discharge after Snubber installation and downstream of Snubber: Maximum peak pressure change 4 lb; line pressure 480 lb.

Send for your copy of a typical Burgess-Manning Pulsation Survey and Analysis Report

BURGESS-MANNING PULSATION SURVEY

Burgess-Manning pulsation surveys are conducted by trained and fully experienced engineers with electronic equipment including pressure pickup (transducer), amplifier, and oscilloscope. The pressure transducer is coupled as close to the gas stream as possible and faithfully reproduces in voltage the pressure changes in the pipe. This voltage is conducted to a three stage amplifier and then to the oscilloscope screen. Photographs are taken of the screen as a record of surge. Data is taken and recorded. Maximum peak pressure change is calculated. Report is prepared. Recommendations are made that best solve your problems.

CONSULT BURGESS-MANNING ENGINEERS

Gas pulsation in compressor piping systems often results in excessive vibration and material fatigue. This, in turn, necessitates constant maintenance in piping and equipment resulting in lower over-all plant efficiency.

Your compressor system pulsation problem can be solved by Burgess-Manning Company engineers. This division maintains a field service to make surveys and analyses of flow conditions in pressure piping. Trained engineers correlate this data for reference in making Burgess-Manning Gas and Air Line Snubber recommendations for new plants as well as for existing plants.

Write for your copy of a typical case history in which Burgess-Manning engineers solved a tough problem.

Typical application showing Burgess-Manning Gas and Air Line Snubbers installed on discharge side of multiple-stage gas compressors.

Burgess-Manning Gas & Air Line Snubber.

BURGESS-MANNING COMPANY

1203 Dragon Street

Chicago, Illinois — **DALLAS, TEXAS** — **Libertyville, Illinois**

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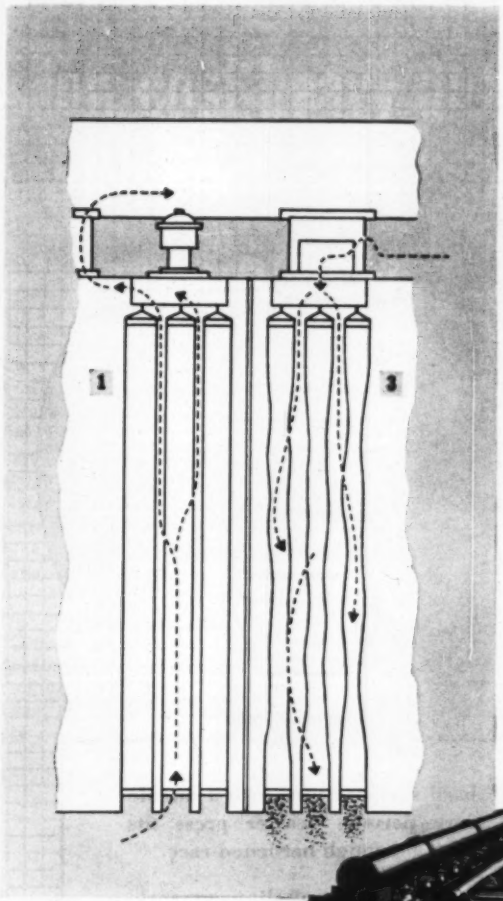
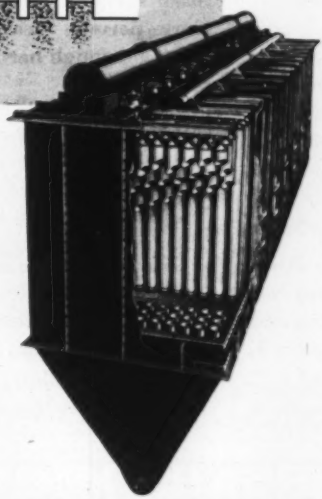


How Norblo gives you 24-hour-a-day dust collection at full rated capacity

Fast double-action bag cleaning assures full efficiency and constant suction drop across the arrester

No matter what the task in large scale continuous operation, Norblo equipment stands the gaff — with low maintenance and economical over-all cost. Norblo Automatic Bag Type Dust Collectors have been completely reliable in all types of installations for over 25 years, proving the soundness of the operating principles described below:



1 Basic unit compartment houses 78 cylindrical bags — fully distended by upward inside air flow.

2 Variable timing of cleaning cycle, easily adjusted according to dust load, insures constant volume of air handled and constant static pressure drop across the arrester.

3 Bag cleaning involves only one compartment at a time, and only a few seconds out of each hour of operation. During cleaning period bags are shaken and air flow is reversed, loosening dust and accelerating its descent into the hopper. *This double-action bag cleaning insures utmost efficiency of the equipment and in no way interrupts the suction drop.*

4 Any compartment may be cut out of operation for bag replacement or repair, all other compartments remaining in operation.

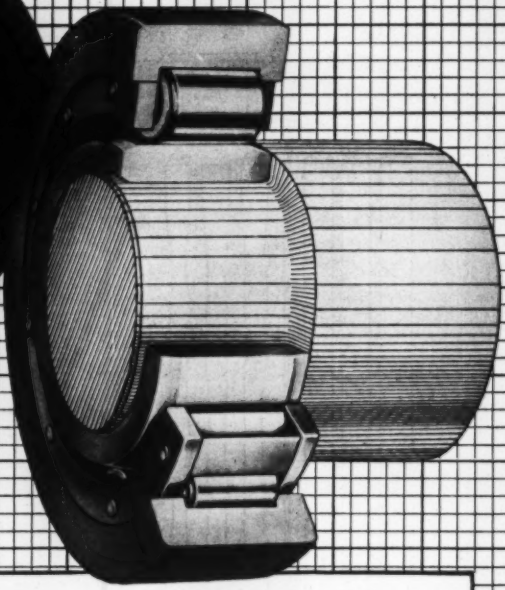
Norblo Equipment is completely designed and fabricated in our own shops and sold on the basis of *guaranteed performance*. Let us send you Bulletin 164-3.

THE NORTHERN BLOWER COMPANY

Engineered Dust Collection Systems for All Industries

6421 Barberton Ave. • Cleveland 2, Ohio

Heavier Press Fits with HYATT HY-LOADS



THE simplest way to mount bearing inner races is by press fitting. Hyatt Hy-Load Roller Bearings are designed and constructed to permit relatively heavy press or shrink fits of races—fits sufficient to retain races properly without resorting to auxiliary devices such as snap rings, lock nuts or keys.

This is possible because Hyatt Hy-Load races are made from carburizing type steels, carburized and heat treated to provide hard, wear resistant, case-hardened surfaces with tough ductile cores. A hard surfaced race with a ductile core permits heavier press fits than a through hardened race.

The hazards of slippage, cocking or eccentricity, always present with loose fitting races clamped endwise, are avoided when races are properly press fitted.

For more information about this and many other features of Hyatt Hy-Load Roller Bearings, write for Catalog 547. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

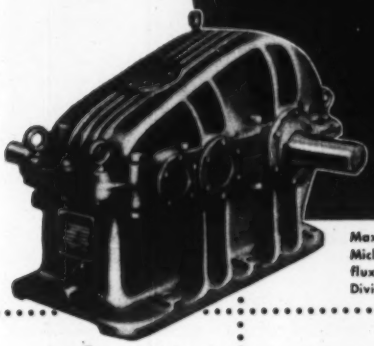
low cost heavy duty service with Foote Bros. MAXI-POWER

Costs go down when Foote Bros. Maxi-Power drives are installed! These rugged helical gear drives assure high efficiency — low maintenance costs — operate day after day, year in and year out without trouble and with minimum maintenance.

Precision-Generated Helical Gearing with uniform load distribution across the entire face permits maximum load carrying capacity in minimum space and assures the maximum in reliable, uninterrupted performance.

These drives are available in single, double and triple reductions, with ratios ranging from 2.08 to 1, up to 360 to 1. Capacities up to 1550 h.p.

FOOTE BROS. GEAR AND MACHINE CORPORATION
4545 South Western Blvd. • Chicago 9, Ill.



Maxi-Power drive at Murray Corporation of America, Ecorse Michigan Plant, driving tubular conveyor handling welding flux. Designed and manufactured by Hapman Conveyor Division of Hapman — Dutton Co., Kalamazoo, Michigan.

FOOTE BROS.
Better Power Transmission Through Better Gears

Foote Bros. Gear and Machine Corporation
Dept. Q, 4545 S. Western Blvd., Chicago 9, Ill.

Please send Bulletin MPB containing full information on Maxi-Power Drives.

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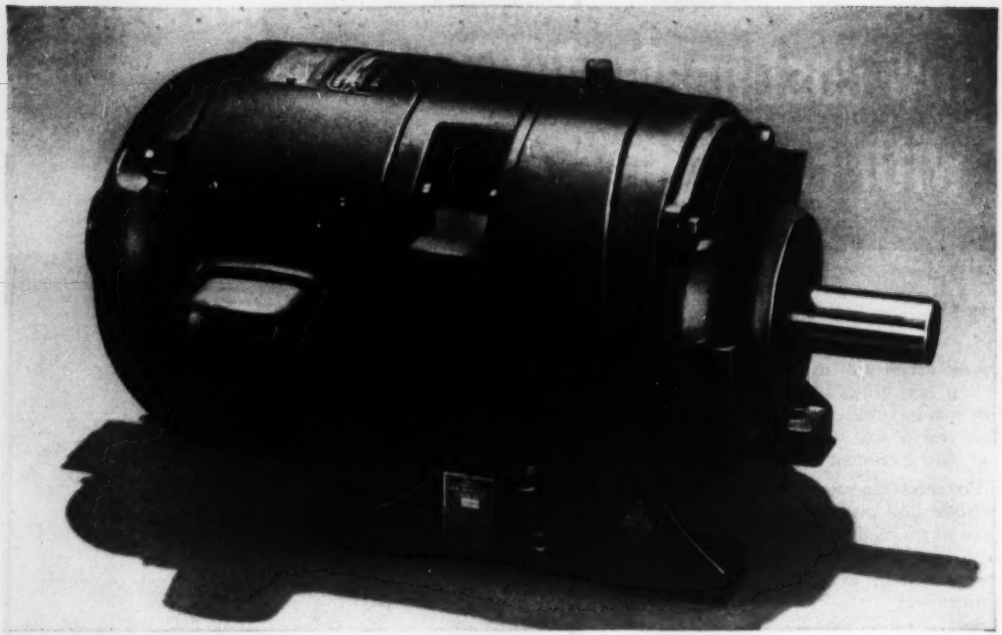
Company .....

Position .....

Address .....

City ..... *State* .....



G.E. Announces Improved Gear-motor Design

Maintenance costs and time cut more than 50% by new gear-motor

General Electric's improved gear-motor is a single unit—a superior low-speed drive, now redesigned to further reduce maintenance costs. Here's how!

STATOR REMOVAL may now be accomplished without disturbing the gear train in any way. Simply remove the endshield, the four bolts which secure the stator, and pull off the stator. Because this is part of the complete line of *standard* G-E motors, you can use *any* G-E motor stator of the same size as a replacement.

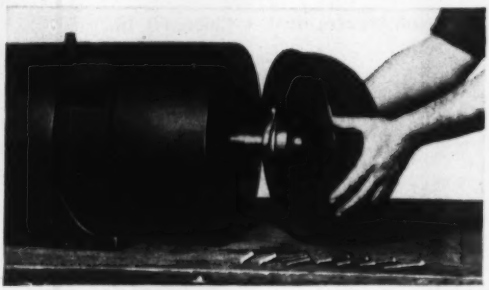
TRI-CLAD* MOTORS—the most reliable, most widely-accepted motors available—are now an integral part of *every* G-E gear-motor, either open or totally enclosed. All open gear-motors have dripproof construction.

PROMPT SHIPMENT is made possible by G.E.'s new stocking plan, which keeps popular ratings stocked at multiple points throughout the country. In addition, over 250 models are now on a one-week shipping schedule from the factory.

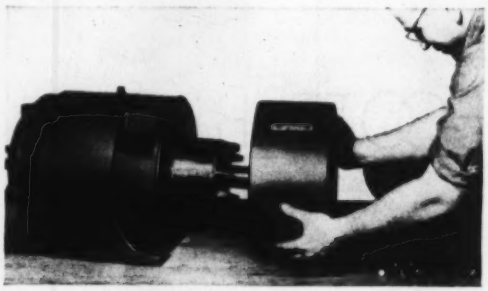
G-E gear-motors, being single units, are easier to install and maintain than motors coupled to separate, external gear reducers. They're available in standard enclosures to fit any application. Order your G-E gear-motor through your nearest G-E Apparatus Sales Office, or your Authorized G-E Agent or Distributor. General Electric Company, Schenectady 5, N. Y. 755-9

*Reg. trade mark of General Electric Co.

GENERAL ELECTRIC



ENDSHIELD REMOVAL is a simple matter. Remove the bearing-cap and endshield bolts, and lift the endshield from the stator.



STATOR REMOVAL now consists of just removing the four stator bolts and slipping the stator from the gear-motor housing.

STUDENT MEMBERS

OF THE ASME

you can get—

A LITTLE CASH!
A LITTLE FUN!
A LITTLE FAME!

HERE'S your opportunity to get that for which you have lacked the wherewithal. There's just one catch — you will have to work for it! If you quit easily — don't read any further. Perhaps a little extra work on your thesis will do the trick.

An engraved certificate signed by the President and Secretary of the Society will accompany each award.

A trip to the Annual Meeting as a guest of the "Old Guard" will be awarded.

Students should consult the Honorary Chairman regarding the rules for these awards. Only papers by single authors will be considered.

Each student must submit his paper to the Vice President of the Region in which his Student Branch is located not later than June 1, 1953

$150.00

For the best paper by an undergraduate on a given subject. When it has been selected it will be sent to the Student Branches. This is the Charles T. Main Award.

An undergraduate must submit his paper for the Charles T. Main Award or Undergraduate Student Award before thirty days after the completion of his undergraduate work.

$25.00

For the best paper on an engineering subject by an undergraduate. This is the Undergraduate Student Award.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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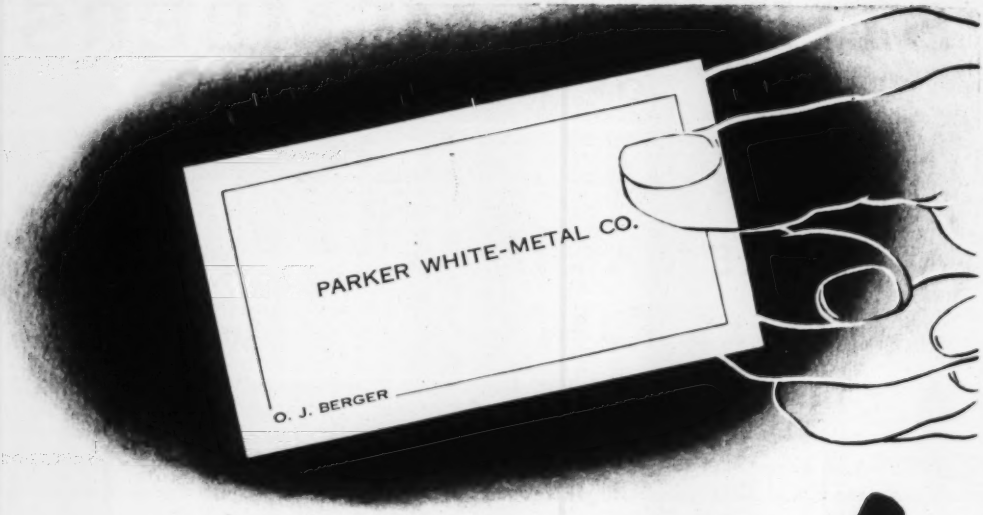


You'll want to see this Man!

He can help YOU

The Parker representative sells more than just Die Castings . . . he offers to you an engineering and design service. He can show you how that difficult part can be produced quickly, economically, of exactly the right alloy and strength to meet your exacting requirements. Parker is one of the oldest names in Die Castings. The experience and know-how here at Parker is yours for the asking. Parker Die Castings have been designed and produced for nearly every industry. We are certain that we can help YOU. Call on Parker engineers on your next design problem.

OLLIE J. BERGER COMPANY, 139 North Clark Street, Room 1415, Chicago 2, Ill. Dearborn 2-4954 • WILLIAM H. BROXTERMAN, 2174 Buck Street, Cincinnati, Ohio Cherry 1623 • J. C. PALMER, 712 State Tower Building, Syracuse, N. Y. Phone 2-0194 • GIRARD L. PALMER, 405 Farmington Avenue, Hartford Connecticut Hartford 3-1987 • HODGSON-GEISLER CO., 18917 James Couzens, Detroit 35, Mich. Diamond 1-2580 • LARRY WARD, 1500 La Salle Avenue, Minneapolis, Minn. Atlantic 1331 • WARREN G. OLSON, 420 East Linn Street, Bellefonte, Penna. Phone 4852 • DANIEL F. MARSH, 35 Chestnut Street, Girard, Penna. Phone 3070 • EDWARD F. HIGGINS, JR., 4931 Laclede Avenue, St. Louis 8, Mo. Forest 6541

And when you think of Die Castings **- - THINK OF**

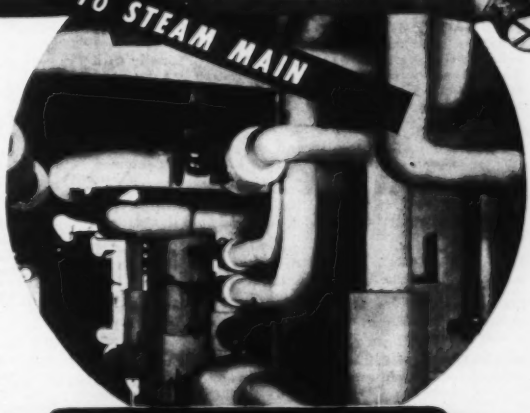
Parker White-Metal Company • 2153 McKinley Ave. Erie, Penna.

PARKER ALUMINUM *and* ZINC *Die Castings*

WHEN THE PRESSURE IS ON P.P.&E. PIPING

has what it takes

FROM CONTROL PIPING TO STEAM MAIN



Today's 1000°F and higher temperatures, combined with pressures in the 2000 psi range — really "put the pressure" on a piping system. It could be said that these higher, and perhaps even higher pressures to come, will force new standards of piping.

But—remember when 750°F was considered to be a high reheat temperature? Even then, P.P.& E. was ahead of the needs in piping to carry the load. As the trend toward higher temperatures continued—P.P.& E. has kept ahead of the requirements.

That's why conditions encountered in present-day reheat temperatures are thoroughly understood by P.P.& E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

When the "pressure is on" you can depend on every part of a P.P.& E. piping system—from the steam main, right down to the air lines.

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AND EQUIPMENT COMPANY

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INSTRUMENTS
AND CONTROLS

Do You Know About ALL of the **REPUBLIC** *Line?*

Check the Republic line of measurement and control equipment listed below. You'll find instruments and controls to meet your needs—whether for a simple control or an automatic control system. And teamed with this equipment is an experienced engineering staff which can give you the right answer to your measurement and control problems.

☐ **ELECTRICAL FLOW METERS.** For metering the flow of steam, water, gas, air, oil, brine, etc. The reading instruments, indicator, recorder and integrator, are remote reading and can be supplied singly or in any combination desired. Integration is continuous, an exclusive Republic feature.

☐ **PNEUMATIC TRANSMITTERS.** For converting process variables such as flow, liquid level, pressure, or liquid density into air pressures which vary proportionally with the process variables. These air pressures can be used as a measuring impulse for the actuation of an automatic controller or a direct reading recorder.

☐ **CO_2 METERS.** Provide a continuous record of percent CO_2 in flue gas measured by the Orsat method. Furnished with either mechanical or electrically actuated remote reading indicator and recorder.

☐ **DRAFT INSTRUMENTS.** Indicating or recording types in single or multiple units. Furnished in all standard ranges of draft and pressure.

☐ **THERMOMETERS.** A long distance, gas filled thermometer with either single or multiple pen recorder.

☐ **LIQUID LEVEL INSTRUMENTS.** Remote reading indicators and recorders. Also provided with various types of alarm devices.

☐ **MULTI-POINT INDICATORS.** Will indicate, on separate vertical scales from two to sixteen units of draft, pressure, flow, temperature, CO_2, etc., in any combination desired.

☐ **MULTIPLE RECORDERS.** Strip Chart Type will record from three to six separate records of flow, temperature, CO_2, pressure, etc., in any combination desired. Round Chart Type can have up to 4 pens.

☐ **REGULATORS.** For the automatic control of pressure, draft, rate of flow, rate of fuel feed, speed of rotation, liquid level, etc. For proportioning two pressures or flows. Regulators may be either air or oil operated. Flexibility in design and construction allows the regulator to perform any type of control action. Setting may be remote or manual.

☐ **AUXILIARY RELAYS.** Multiplying, dividing, adding, subtracting, maximum and minimum setting, ratio, ratio computing, sequential, splitter, squaring, square root extracting, and position indicating.

☐ **COMBUSTION CONTROLS.** A centralized, automatic system for controlling steam pressure, combustion, furnace pressure, excess pressure, boiler level, etc. Automatically regulates the fuel and air input to a boiler in measured proportions and in a fixed ratio for the entire load range. Adaptable to multi-fuel firing.

☐ **DESUPERHEATERS.** Atomizing type desuperheater uses a small quantity of high pressure steam to vaporize an automatically controlled amount of water in reducing steam temperature to the desired degree.

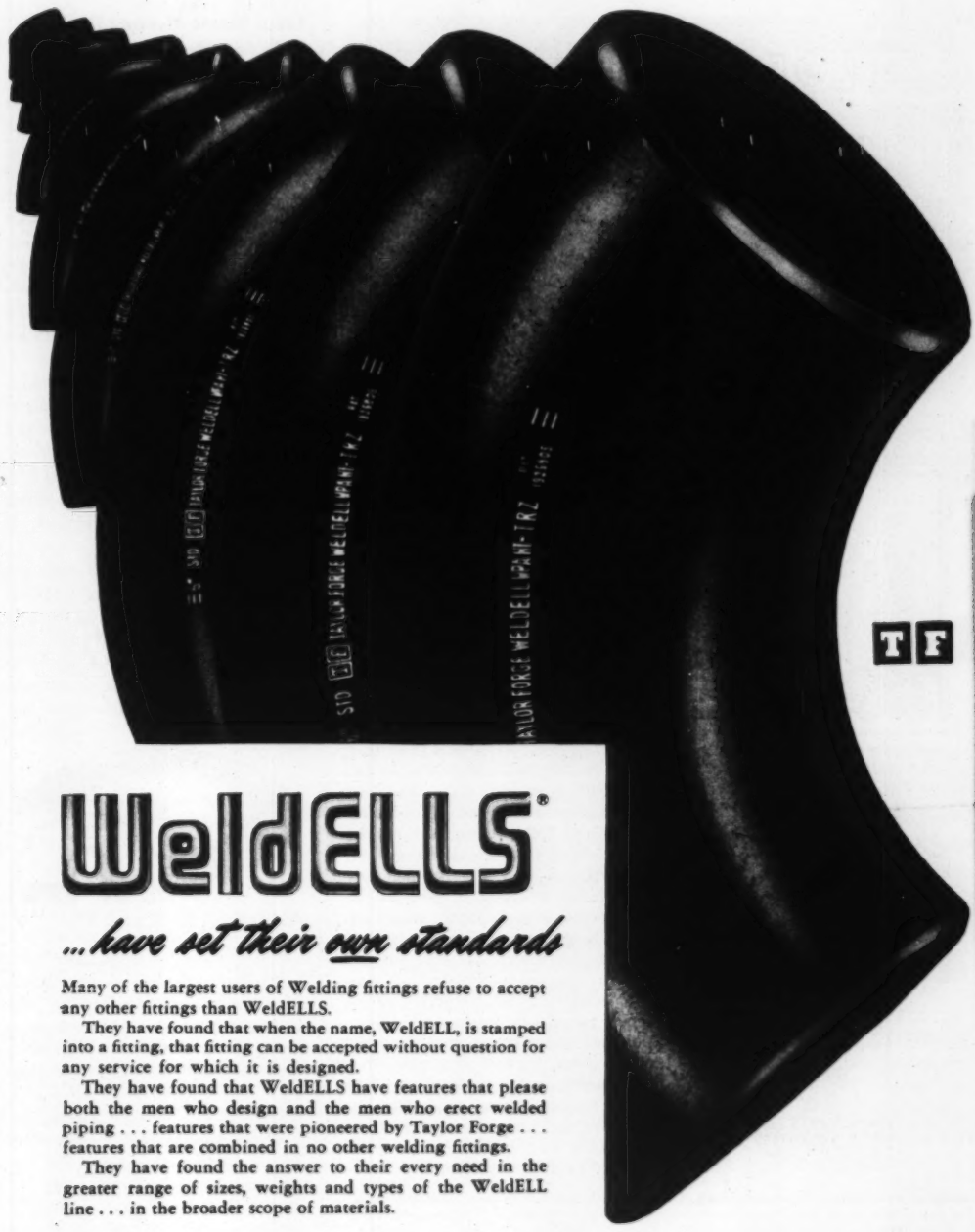
☐ **VALVES—REGULATING AND PRESSURE REDUCING.** Designed and built for all practicable ranges of pressures with either flanged or welded ends. Special body design sharply reduces erosion and noise. Cylinder operated valves available in sizes from 3 in. to 24 in. Hand operated valves in sizes from 1 in. to 8 in. Lever operated valves in sizes up to 16 in. Republic valves are built in accordance with A.S.A. Standards for all pressures up to 2500 psi. Diaphragm operated valves are available for pressures from 125 to 1500 psi and from 3 in. to 10 in. in size. Special purpose alloy steel butterfly valves in sizes 4 in. to 24 in. are also available.

Data Books are available on any of the above equipment

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway • Chicago 47, Illinois

BRANCH OFFICES: **Atlanta • Albuquerque • Boston • Buffalo • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston Indianapolis • Kansas City, Mo. • Los Angeles • Minneapolis • New Orleans • New York City • Philadelphia • Phoenix • Pittsburgh Richmond • St. Louis • Salt Lake City • San Francisco • Seattle • Syracuse • Shreveport • Tulsa • Vancouver, B. C.**



WeldELLS®

...have set their own standards

Many of the largest users of Welding fittings refuse to accept any other fittings than WeldELLS.

They have found that when the name, WeldELL, is stamped into a fitting, that fitting can be accepted without question for any service for which it is designed.

They have found that WeldELLS have features that please both the men who design and the men who erect welded piping . . . features that were pioneered by Taylor Forge . . . features that are combined in no other welding fittings.

They have found the answer to their every need in the greater range of sizes, weights and types of the WeldELL line . . . in the broader scope of materials.

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

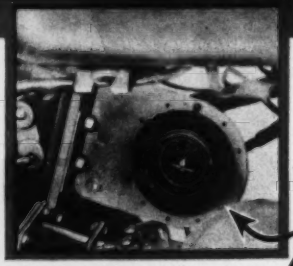
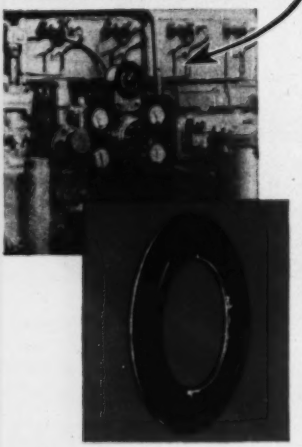


Photo Below Courtesy Cummins Engine Company, Inc.



The Sure Way to "Design out" Vibration and Shock Damage.

Lord Meter Mountings are paying dividends to manufacturers and users of heavy duty industrial and farm tractors, lift trucks, stationary engines and many other industrial machines where shock and vibration are encountered.

The Lord Meter Mount assures the accurate performance designed into Hobbs Engine-Hour Meters when they are subjected to excessive vibration on farm tractors and stationary diesel engines. These meters are protected from the damaging effects of vibration and shock by the unique method of combining shear and rolling action of the rubber to absorb destructive forces. The outer ring is mounted to the panel and the inner ring holds the meter thus giving protection in multi-planes. The rubber between these rings does the work. We will be pleased to have the opportunity to help you in the application of Lord Meter Mountings.

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LORD MANUFACTURING COMPANY • ERIE, PA.

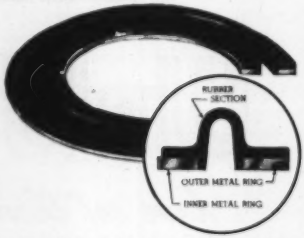
LORD HEADQUARTERS FOR VIBRATION CONTROL

Lord Meter Mounts Prolong Life . . . Protect Accuracy of Sensitive Instruments

Damaging shock and vibration forces are absorbed in the unique design "U" shaped rubber section, separating the inner and outer metal mounting rings of Lord Meter Mounts. This protective rubber barrier combines rolling and shear action to prevent passage of destructive forces; thereby insuring maximum accuracy and performance of the delicate internal mechanism of instruments.

Considering the light weight of instruments and their functional characteristics, the inherent softness and multiplane flexibility of Lord Meter Mounts insure a high degree of protection against vibration and shock conditions prevalent in industrial installations.

Highly successful have been the many varied field-proved applications where Lord Meter Mounts have been used to protect instruments in aircraft, ships, portable power plants, electronic equipment, control panels and communications equipment.



Typical of the Lord Meter Mounting applications are the Hobbs Engine-Hour Meters in wide use to record the actual running time of Diesel Engines on tractors and earthmoving equipment and on stationary diesel power plants.

While the Hobbs Engine-Hour Meter is designed to withstand rugged use and normal vibration and shock conditions, its mechanical sturdiness is enhanced materially by the Lord Meter Mounting. Not only do Lord Meter Mounts protect the accuracy of the instruments which they cradle in bonded rubber, they make instrument readings much easier, and prolong the func-

(*Continued on next page*)

tional life of the instrument with less maintenance as a by-product.

Lord Meter Mounts are furnished in a wide range of diameters, require only ½ inch larger radius for installation than unmounted meters, are easily installed without the need of brackets. Full details will be furnished by Lord Manufacturing Company, Erie, Pa.

Appliance Manufacturers Profit By Using Lord Mountings To Isolate Vibration and Shock

Efforts to "design out" of modern appliances the irritating and damaging factors of vibration and shock meet with considerable success when Lord Mountings and Bonded-Rubber parts are selected while the product is in the early design stage.

An outstanding example is the famous Blackstone Automatic Washer, boon to housewives the world over. The use of a specially designed Lord bonded neoprene flexible coupling isolates the normal vibration which would accrue to the uneven loading of the tub during the spinning cycle. This coupling not only drives the tub with its full load of clothes during the spin cycle, but acts as a pivot, allowing the tub to float freely within the outer shell.

This combined flexible drive and pivot prevents transfer of shock and vibration to the base and outer shell of the washer. During the draining cycle, the Lord coupling supports the entire weight of the tub, the clothes, and a full load of water, a total weight of approximately 200 pounds. In each of its functions this Lord full bonded neoprene coupling is stressed in shear, resulting in maximum flexibility.

Other examples of product improvement by isolating vibration and shock through the use of Lord Precision Bonded-Rubber Products are found in room air conditioners, air circulating fans, food and juice mixers, ice cube dispensers, portable sanders, to name but a few.

Lord Manufacturing Company, Erie, Pa. invites inquiries from design engineers whose problems involve vibration and shock isolation or power transmission.

LORD Bonded-Rubber Mountings used in basic design help to increase sales for leading appliance manufacturers. Inherent Vibration and Shock are actually "designed out" of the appliance, resulting in smooth operation and longer service life. For instance, the famous Blackstone Automatic Washer does its work quietly and efficiently with the "spin dry" basket mounted on the Lord bonded-rubber flexible mounting. This Lord bonded-rubber flexible mounting compensates for unbalanced loading of the "spin dryer" during the clothes-drying cycle. This is another of many examples in which Lord engineering experience and precision manufacturing technique combine to advantage in basic design to speed up and increase end product sales in highly competitive markets. Consider increasing consumer preference for your product by using Lord vibration and shock control mountings.

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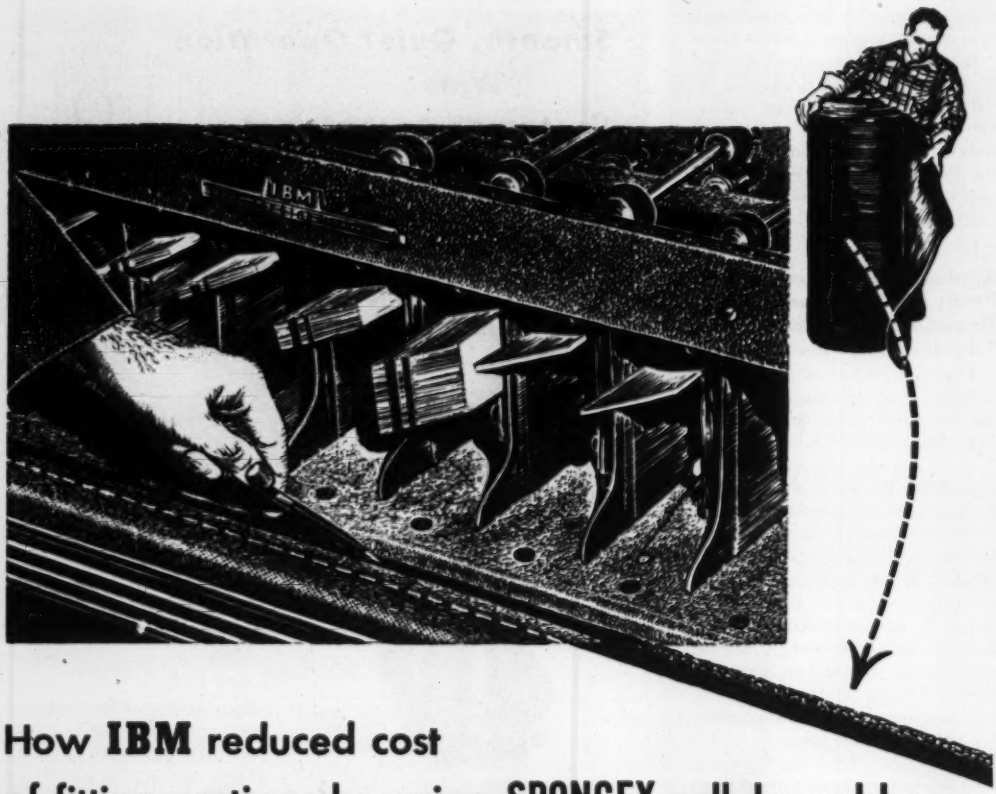
LORD MANUFACTURING COMPANY • ERIE, PA.

LORD HEADQUARTERS FOR VIBRATION CONTROL



How **IBM** reduced cost of fitting castings by using SPONGEX cellular rubber

To get a perfect fit between the base casting and the apron on this card sorter, could be an expensive machining and fitting job. Instead IBM used an inexpensive strip from Spongex sheet stock to economically and successfully compensate for the surface variations of these metal parts.

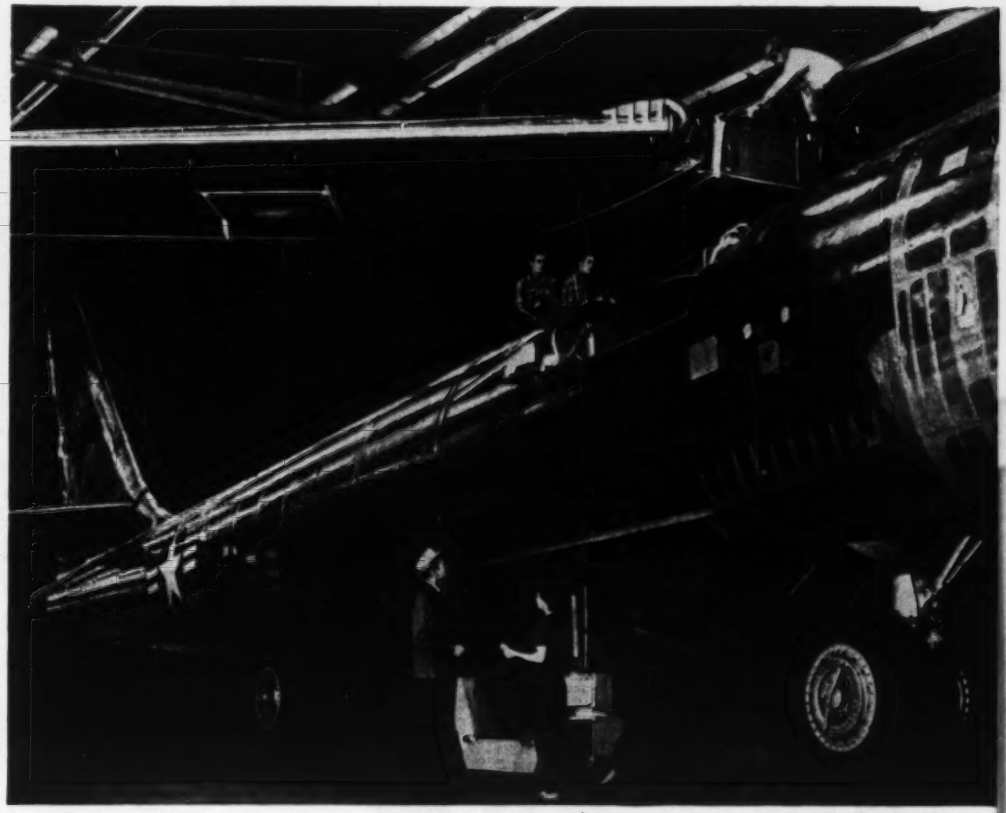
Many production problems can be solved just as easily with an inexpensive form of Spongex. Gasketing, vibration damping, sealing, shock absorption . . . are only a few of the hundreds of applications of Spongex sheet stock.

You might cut your own needs from Spongex sheets and rolls. Or we'll die-cut to your specifications. If you want flame resistance, oil resistance, low temperature performance or high . . . there's a Spongex sheet stock compounded for the job.

SPONGEX® Cellular Rubber

for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY 501 Derby Place, Shelton, Conn.



Top production teams back up Boeing engineers

When Boeing engineers developed the revolutionary, flexible-wing B-47, their designs called for aluminum forgings larger than any ever before made, and for a completely new kind of wing "skin" ranging in thickness from 5/8" at the body joint to 3/16" at the tip.

New techniques, machines and procedures had to be worked out. Production is so precise that the eight-ton wing slips into place with less than a hairsbreadth of clearance. Many of these new procedures were thought "impossible" a few years ago. Today they are routine in Boeing plants. That's the kind of production teamwork Boeing engineers expect—and get.

Boeing engineers also enjoy the advantages of the finest research facilities in the industry. Their work, over the past 35 years, has given them tremendous prestige. You can share that prestige by becoming a Boeing engineer. You'll work on such long-range projects as guided missiles, nuclear-powered aircraft and the exploration of supersonic flight.

There are openings at Boeing right now for experienced and junior engineers in all fields, for aircraft

- **DESIGN**
- **DEVELOPMENT**
- **RESEARCH**
- **PRODUCTION**
- **TOOLING**

also for servo-mechanism and electronics designers and analysts, and for physicists and mathematicians with advanced degrees.

You can choose our Midwest plant at Wichita, or work in the Pacific Northwest at Seattle. Boeing provides a generous moving and travel allowance, offers you special training, a salary that grows with you—and a future of almost limitless range.

You'll be proud when you say, "I'm a *Boeing* engineer!"

Write today to the address below, or use the convenient coupon

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. No. M-10
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

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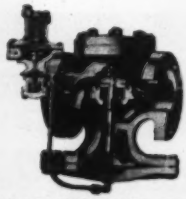
BOEING

Looks like we're using
SPENCE REGULATORS
all over our plant

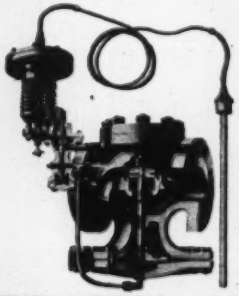
This busy plant has ordered and re-ordered Spence Regulators for two good reasons. (1) Spence offers a *wide-range line* to handle a host of regulating jobs. (2) What's more, Spence units give accurate service year after year. Maintenance is negligible. Over-all costs are low. These design features explain why . . .

- **Single Seat Packless Construction**
- **Large Balanced Metal Diaphragm**
- **Sensitive Pilots**
- **SECO Metal Seats and Discs**
- **Springs out of path of steam**
- **No dismantling for inspection**

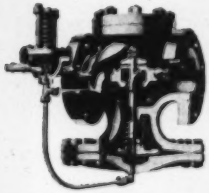
Write for Bulletin 350 for complete details on Spence's line of automatic regulating valves.



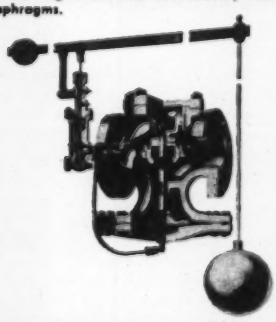
PRESSURE REDUCING—Self-operated, dead-end regulators powered by large, frictionless, metal diaphragms. Sizes 1/4 in. to 12 in. Pressures to 600 psi 750F.



TEMPERATURE REGULATING — Combined temperature and pressure control. No separate reducing valve required. Shuts tight, will not wiredraw or be damaged by overheating. Sizes to 12 in.



BACK PRESSURE CONTROL—Wide selection of sensitive pilots to meet exacting requirements. Initial pressure closing, guaranteed to shut tight. Packless construction, metal diaphragms.

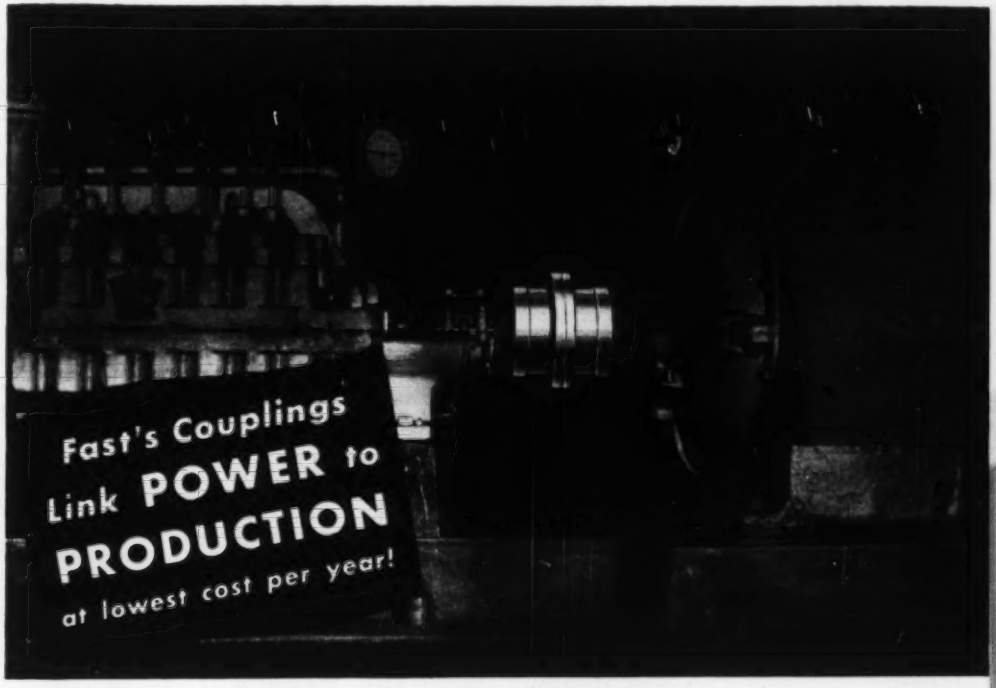


LEVER OPERATED—Pilot lever for connection by cable or mechanical linkage to floats or other devices. Slight actuator motion opens and closes main valve.

SE 110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence



Over half a million FAST'S Couplings now in use!

THROUGHOUT industry, Fast's are rated the most dependable couplings on the market... to the tune of over half a million now in service! Year in, year out, they continue to *outlast the equipment they connect* . . . save time, maintenance and money by eliminating costly coupling failures.

Actual cases on record show many Fast's Couplings have been in operation for 25 and 30 years without trouble. And every major producer of high-speed equipment now uses Fast's!

Solve your coupling worries! Write today for full details on Fast's Couplings and Koppers Engineering Service to: KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 350 Scott St., Baltimore 3, Maryland.

Here's How FAST'S Save You Money

Free Service—Koppers free engineering service assures you the right coupling for the job.

Rugged Construction—Fast's still maintains its original design, without basic change or sacrifice in size or materials. Result: freedom from expensive coupling failures.

Lowest Cost per Year—Fast's Couplings usually outlast equipment they connect. Their cost may be spread over many years!

KOPPERS

FAST'S
THE ORIGINAL
GEAR-TYPE
Couplings

INDUSTRY'S STANDARD FOR 32 YEARS

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*
350 Scott St., Baltimore 3, Md.

Gentlemen: Send me Fast's Catalog which gives detailed descriptions, engineering drawings, capacity tables and photographs.

Name _____

Company _____

Address _____

City _____ *Zone* _____ *State* _____

There are hundreds of jobs open to engineers today!

but few opportunities like these

Westinghouse is in nuclear power to stay. We believe in the development of atomic energy as man's next great source of power. If you want to get in on a new era in industry, we want to talk to you.

Atomic power opportunities are waiting now for mechanical engineers with 4 to 10 years of this kind of experience...

DESIGN OR APPLICATION—light and heavy structural supports for machinery . . . high pressure piping and systems . . . rotating machinery . . . steam turbines, general steam apparatus and steam power systems . . . heat exchangers and condensers . . . hydraulic apparatus and systems, fluid flow, systems evaluations, heat balance, valve design . . . mechanical and hydraulic devices and mechanisms (thorough knowledge of properties of materials required).

LIAISON—coordination with subcontractors and customers . . . scheduling and planning of ship trials and customer testing of nuclear powered steam plants.

SUPERVISION of drafting work.

REMEMBER! We are primarily interested in good *experienced* application and development engineers—lack of previous reactor development experience *is no handicap in this type of work.*

HOW TO APPLY! What Westinghouse wants to know is: Where and when you obtained your degree . . . how you did in school . . . where you have worked at your profession . . . what kind of work you have done.

In other words, right now we're more interested in your ability to fill current openings and to develop in the Westinghouse Atomic Power Division than we are in your vital statistics. Write your letter of application accordingly.

You will be in communication with men who are experienced in keeping secrets. All negotiations will be discreet, and your reply will be kept strictly confidential.

Address your application letter to: Manager, Industrial Relations Department, Westinghouse Electric Corporation, P. O. Box 1468, Pittsburgh 30, Pennsylvania.

What do you want?

MONEY? Good jobs are open here now—waiting for good men who want to make a permanent connection.

A PERMANENT JOB? Many of the engineers who joined Westinghouse 20 and 25 years ago are still with Westinghouse—and in key positions—and engineers who join us now will have the opportunity to make this work their lifetime careers. When many other industries may be going through slack times, atomic energy will still be in a stage of expansion.

SUBURBAN LIVING? It's here—within easy driving distance of your work. Within a few minutes of shopping centers . . . schools . . . metropolitan centers.

JOB EXTRAS? Westinghouse offers: Low cost life, sickness and accident insurance with hospital and surgical benefits. A *modern* pension plan. Westinghouse stock at favorable prices. Westinghouse appliances for your home at discount.

YOUR KIND OF ASSOCIATES? Every fourth person in the Division is an engineer or scientist. More than half the top Westinghouse executives are engineers.

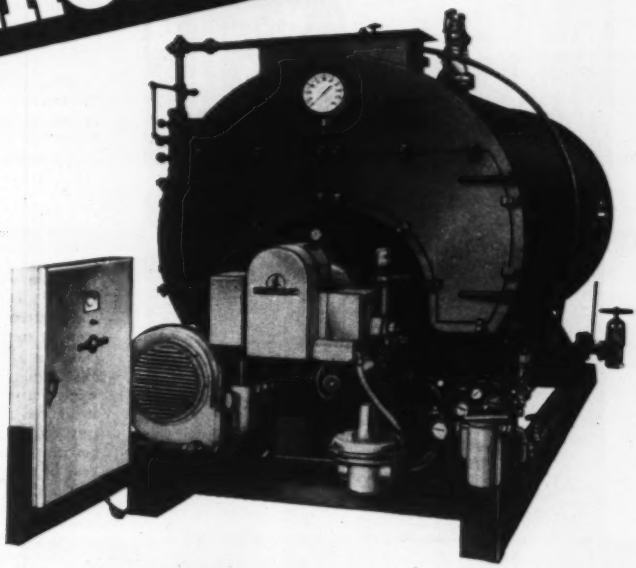
FASCINATING WORK? What other branch of science offers such exciting challenges? So many opportunities for discovery? So many chances to benefit mankind? So many opportunities for original work?

GROWTH OPPORTUNITIES? Never again in your lifetime will you be able to get into such a sure-to-expand industry so early in its development.

YOU CAN BE SURE.. IF IT'S Westinghouse

KEWANEE and IRON FIREMAN

- *For oil, for gas, or oil and gas firing*
- *For every commercial and industrial application*



Jointly announce a NEW boiler-burner UNIT

Two outstanding companies in their respective fields—Iron Fireman and Kewanee—have combined their engineering talents and their long experience in designing and producing this unique new boiler-burner unit.

Every part has been skillfully engineered for balanced operation to give users what they want; efficient utilization of fuels, with resulting low-cost steam; and fully automatic, dependable performance.

The burner, including all controls, built-in forced draft fan and oil pre-heating system, is completely assembled, wired, tested and shipped to the installation site from Iron Fireman. The boiler, completely assembled with all of its essential elements, is shipped from Kewanee. Matching connections are provided for quick, easy installation.

Available for high pressure steam in sizes with outputs ranging from 52 to 456 h.p., 125 and 150 lb. working pressure, and also from 5470 EDR 15 lb. steam or 30 lb. water. These units may be automatically fired with No. 6 or lighter fuel oils, gas (either high pressure or as low as 2 oz.) or a combination of both fuels.

Send for this 14-page catalog

This catalog, produced in full color, gives COMPLETE information on all sizes and models, including *detailed specifications.*

Use coupon or write

MAIL to KEWANEE or IRON FIREMAN

Name_____

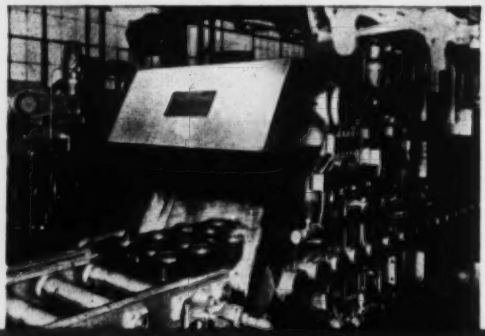
Company_____

Address_____

IRON FIREMAN MFG. CO.
3105 West 106 Street, Cleveland 11, Ohio

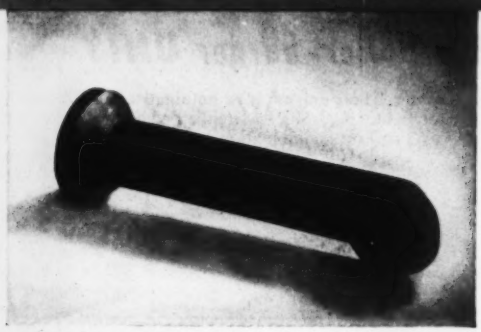
KEWANEE-ROSS CORPORATION
107 Franklin Street, Kewanee, Illinois

Looking for materials



Here is a high temperature, atmosphere furnace used for production brazing of automotive parts. These parts travel through on a cycle from cold, to 2100 F, to cold in 1 hour and 10 minutes. The fixtures holding the parts were formerly made of metal. These warped badly and the parts often stuck. Attempts to overcome the warping by increasing the thickness resulted in fixtures so heavy they absorbed a major part of the furnace heat and added to the load on the roller hearth. When replaced with Super Refractory fixtures, weight was sharply reduced, sticking was eliminated, and the new fixtures *outlasted the alloy about 5 to 1.* The Super Refractory fixtures, of course, cost much less, too.

This is a walking beam furnace (gas fired to 2000-2200 F) in which the bars being heated are periodically lifted and moved from one notch to the next. Step by step, they're walked through to the discharge end. The scalloped work-rests were originally made of alloy. These lasted 4 to 6 months, and almost every week the furnace had to be shut down to repair and straighten these rests. However, when Super Refractory rests were installed, the furnace ran *for 2 years* before the rests required *any* attention. Another full year of uninterrupted service was then obtained with only about 10% replacement. What's more, the initial cost of these rests was less than half the alloy's cost.



An interesting application of Super Refractories where little heat is involved, is this spray nozzle for acids. This particular nozzle is approximately 17" long, and 4" in diameter. Nozzles of this type are used for a variety of different acids. A typical application is in a sulfuric acid plant where weak sulfuric acid is sprayed into an absorbing chamber. The temperature of the sprayed acid is only about 200 F, whereas the temperature of the gases being absorbed is much higher. Therefore, these nozzles have to be made of a material that will not only withstand chemical attack, but also take the shock of this sharp temperature gradient — a job that's made to order for Super Refractories.

Super Refractories by

CARBORUNDUM

Trade Mark

Refractories Division **The Carborundum Company, Perth Amboy, N. J.**

"Carborundum" is a trademark indicating manufacture by The Carborundum Company

to replace alloys?

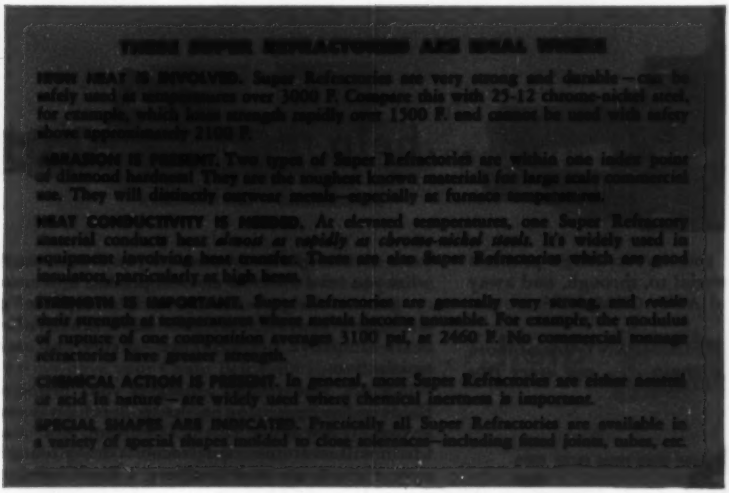
Great strength, plus resistance to abrasion, corrosion and heat, make Super Refractories ideal replacements for many heat resisting metals.

Possessing properties seldom associated with refractories, Super Refractories by CARBORUNDUM have proved superior to metals in many applications. They have been particularly valuable where critical chrome, nickel or cobalt alloys were involved.

For example, Super Refractories have replaced metals for such diverse applications as: skid rails, muffles, wire guides, radiant tubes, roller hearths, brazing fixtures, recuperator tubes, etc. In these cases, they not only released vitally needed metals but outperformed them (by lasting longer than the metals — while also increasing the capacity of the equipment).

As you look over the properties of Super Refractories listed below, draw a mental comparison with your needs. Exactly what makes an alloy essential in this place, or that? Is it refractoriness? conductivity? abrasion? corrosion? strength? It's surprising how often you'll find Super Refractories inherently better — and far less expensive — then metals.

It will pay you to investigate these unique Super Refractories . . . now, before the metals cupboard is bare. Your problem will be given prompt attention.



USE THIS BOOKLET TO CHECK UP. This new booklet contains an easy-to-read analysis of the principal characteristics of these unique Super Refractories. The coupon will bring you the story—or one of our engineers will be happy to talk over your problems. We believe it could be mutually profitable.

Dept. P-102
Refractories Div., The Carborundum Co.
Perth Amboy, New Jersey

Please send me your free booklet on the properties of Super Refractories.

Name_____

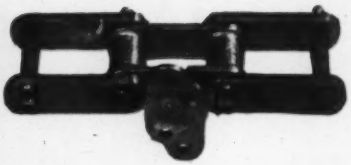
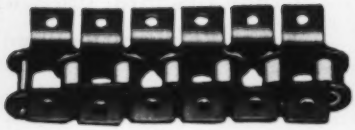
Position_____

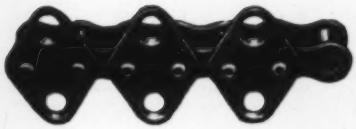
Company_____

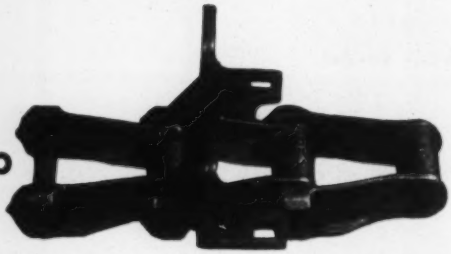
Street_____

City_____ Zone_____ State_____

HELP

help  ...help 

help ...help 

help  ...help

Here's plenty of "HELP" for you if your design problem involves the movement of material to, through, and away from a machine. CHAIN and ATTACHMENTS are the biggest "HELP" you can find.

In the complete CHAIN BELT COMPANY line of more than 2000 sizes and types of chain . . . *and every type has a number of attachments* . . . you'll find exactly what you need for most efficient product movement . . . greatest design flexibility. And, because the line *is* complete, you can choose the chain that will reduce costs—improve performance—insure customer satisfaction.

If exact, split-second timing is your problem, Baldwin-Rex® precision finished roller chain is your answer. If low initial cost is important, Rex® Cast Chain will meet this requirement. If heavy loads at slower speeds are your problem, a Rex Chabelco®

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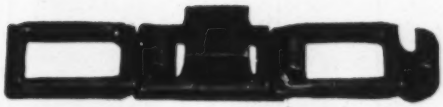
Distributors in all principal cities



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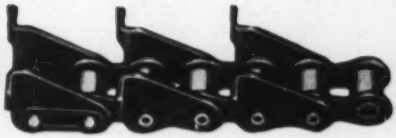

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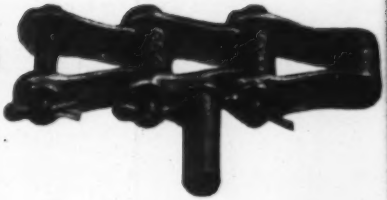

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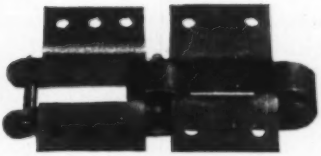

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Steel Chain is the ideal solution. These and the many other types of chains can all be furnished with a wide range of attachments.

To be sure of obtaining the *exact* chain and attachment that will be *exactly* right for your machines, why not have your Chain Belt Field Sales Engineer help you? His specialized knowledge can prove extremely valuable to you in designing for lower cost, improved performance from the equipment you design. Or for helpful information, mail the coupon below.

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Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

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The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

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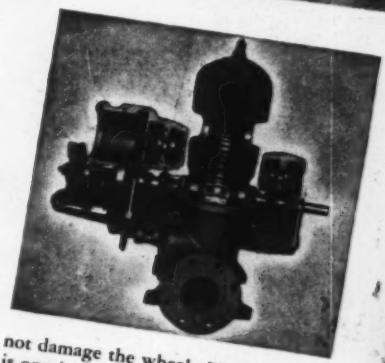
ME-10-52

TERRY

LARGE CLEARANCES *take the "worry" out of* Turbine Operation

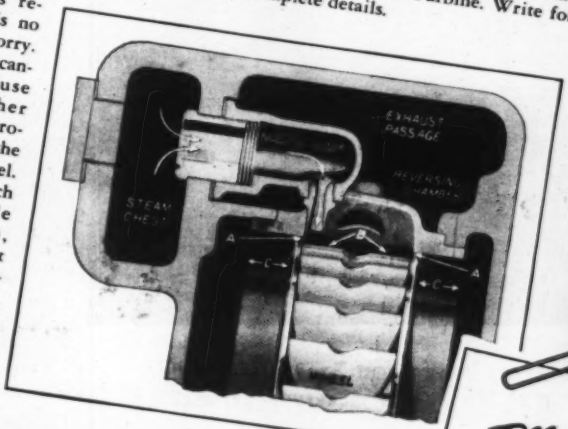


In a Terry Solid-wheel Turbine the power-producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets. This unique design permits unusually large blade clearance—see B in the diagram.

Even if this clearance becomes reduced, there is no real cause for worry. The blades still cannot foul because they are further protected by projecting rims at the sides of the wheel. These rims, which also have ample clearances (AA), will take without damage any rubbing that may occur.

Side clearance, CC, is so large that end-play from external thrust will not damage the wheel. This clearance is one inch or even greater.

Large side and blade clearances are only two of the many features of the Terry Solid-wheel Turbine. Write for complete details.



THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

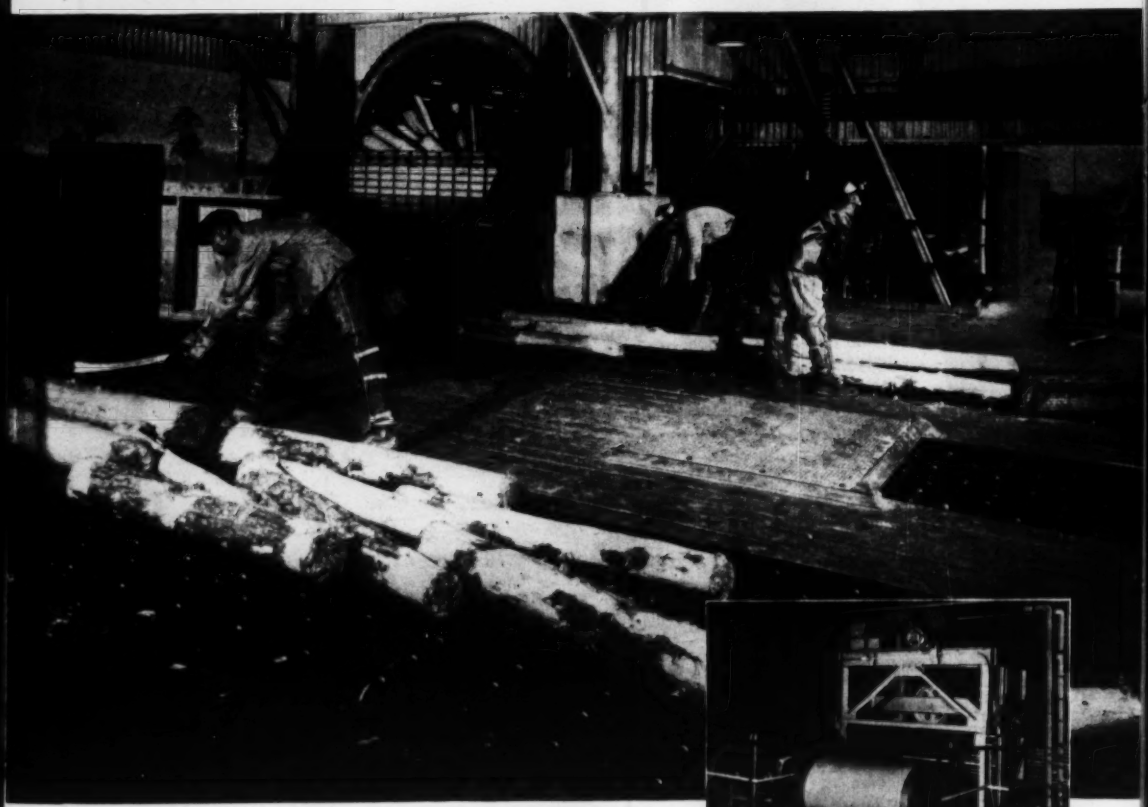
TT-1191

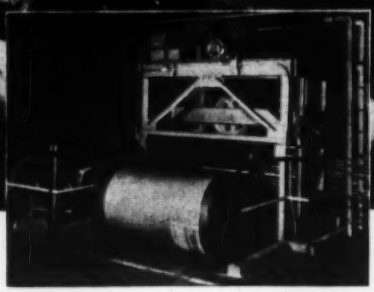
Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

LINK-BELT research and engineering . . . Working for Industry

Complex conversion job-- turning pulpwood logs into paper





Link-Belt equipment for pulp and paper mills includes: chains and sprockets, conveyors, elevators, feeders, screens, cranes and power transmission machinery. Lower photo shows Link-Belt paper roll lowerer delivering newsprint to storage or shipping floor. 12.872

LINK-BELT conveyors help boost production, reduce costs every step of the way in modern paper-making

THIS new paper mill uses scores of Link-Belt conveyors, feeders, and elevators. Logs, chips, pulp, and finally rolls of paper require continuous, high-speed handling. Coordinated with them must be coal, sulphur, limestone, hot lime, and salt cake.

For every step, Link-Belt supplies conveyors and power transmission equipment to this and other leading paper mills. And the majority of the country's high-speed, high-horsepower printing presses are driven through Link-Belt Silent Chain.

It's the same story in industry after industry — Link-Belt research and engineering are making valuable contributions to increased production . . . lower cost. Truly Link-Belt's materials handling and power transmission products are the muscles of mass production.

LINK-BELT

LINK-BELT COMPANY

Executive Offices:
307 N. Michigan Ave., Chicago 1, Ill.
Plants: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa), Sydney (Australia). Offices in Principal Cities.

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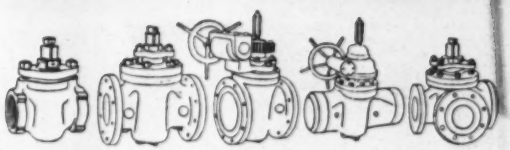
COMPLETE LINES OF LUBRICATED PLUG VALVES

Because of the wide range of services to which Lubricated Plug Valves can be adapted, they may be classed as "all-purpose" valves. Walworth manufactures complete lines of Lubricated Plug Valves in a variety of types and materials for working pressures up to 5,000 psi and for vacuum services. Sizes range from $\frac{1}{2}$ to 30 inches. Write for descriptive literature.

Walworth also manufactures complete lines of gate, globe, angle, and check valves made of steel, bronze, iron, and special alloys.

Walworth valves, pipe fittings, and pipe wrenches total approximately 50,000 items and are sold through distributors all over the world.

Walworth engineers will be glad to help you with your problems. Call your local Walworth distributor, nearest Walworth sales office, or write to our General Offices, 60 East 42nd Street, New York 17, New York.



Illustrated in section is a Walworth No. 1700F Regular Gland Type, Wrench Operated, Steeliron, Lubricated Plug Valve. This particular line of valves has a working pressure rating of 200 psi at 150F or 125 psi at 450F. Sizes range from ½ to 8 inches. Other Walworth Lubricated Plug Valves include Single Gland and Ball Bearing types. They are available for a variety of working pressures.

For best results use Walworth Lubricants and Walworth High Pressure Lubricant Guns.

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Performance records prove.....

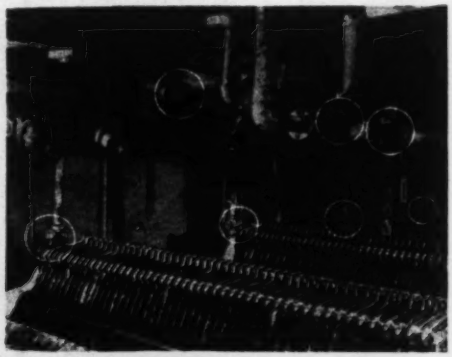
A pottery* in Ohio tried practically every type of valve on its "slip" lines, but the highly abrasive material, at 125 pounds pressure, ruined the average valve in a few months—in some cases, in a few weeks. Our engineers recommended HOMESTEAD Cam-Seald VALVES with special, hard-faced plugs and bodies. The pottery installed them on all "slip" lines in the plant.

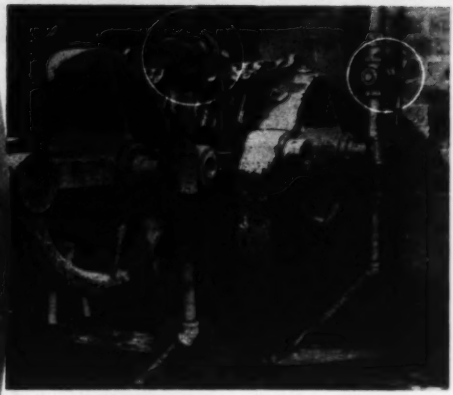
Performance records kept during the past several years show that the HOMESTEADS are lasting more than three times longer than any other valve previously used. Savings in replacement and maintenance costs repay many times over the first cost of the HOMESTEADS.

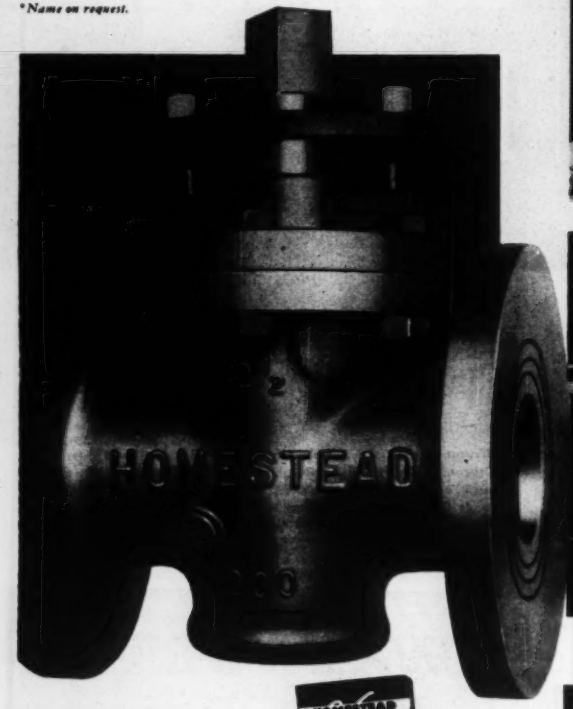
For more than 60 years HOMESTEAD VALVES have been licking equally tough jobs on scores of services in many different types of industries. Chances are there's a valve problem they can solve for you. Why not ask our engineers about it? No obligation.

*Name on request.

HOMESTEAD VALVES are a "Better Buy"







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Instant Forward-Stop-Reverse Control — *at any speed setting — dynamic braking on all models above 1/15 hp*

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Low First Cost — *simple, compact, rugged single-unit construction — can be mounted anywhere near or on machine — no remote cabling necessary*

Easy Maintenance — *essentially maintenance free — VARIAC brush replaced by anyone — controls readily removed from permanently mounted housing without disturbing any wiring*

Prices: VARIAC Motor Speed Controls

1701-AK — 1/15 hp and less (shunt motor)	$75
1701-AU — 1/15 hp and less (series & universal motor)	$75
1700-B — 1/4–1/3 hp (compound motor)	$160
1702-A — 1/2–3/4 hp (compound motor)	$230

(1/15, 1/3 and 3/4 hp standard motors may be purchased from General Radio Company. Prices from $33 to $80.90)

GENERAL RADIO Company

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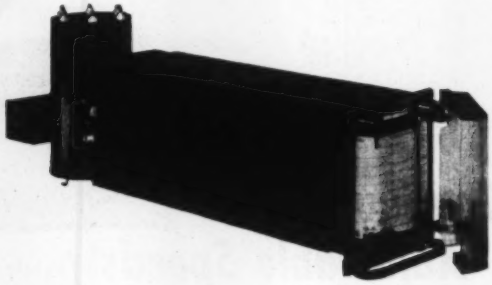
PLUG IN

THE NEW IDEA IN PANEL INSTRUMENTATION



Taylor, pioneer in the 3-part control system, brings many new refinements based on extensive field experience

1. Change from simplest to most complex control by simply unplugging one unit, plugging in another.

2. Change from indicator to recorder or vice versa in only 10 seconds.

3. One mounting for both controller and receiver—recorder or indicator.

4. Recorders or indicators can be mounted on the panel without welding, without drilling holes.

5. Only piping connections required are air supply, controller output, and to variable transmitter. All other connections made automatically in self-sealing manifold.

6. All adjustments can be reached without disturbing any connections.

7. Mountings are extremely simple and rugged.

8. You save panel space by mounting units a few inches apart.

9. Receiver mechanism totally enclosed by protective sleeve.

10. You save money on installation—thanks to simplified piping and mounting.

ADDITIONAL NEW FEATURES IN TAYLOR'S TRANSET® RECORDER:

Continuous valve position indication on separate scale tells valve pressure at a glance.

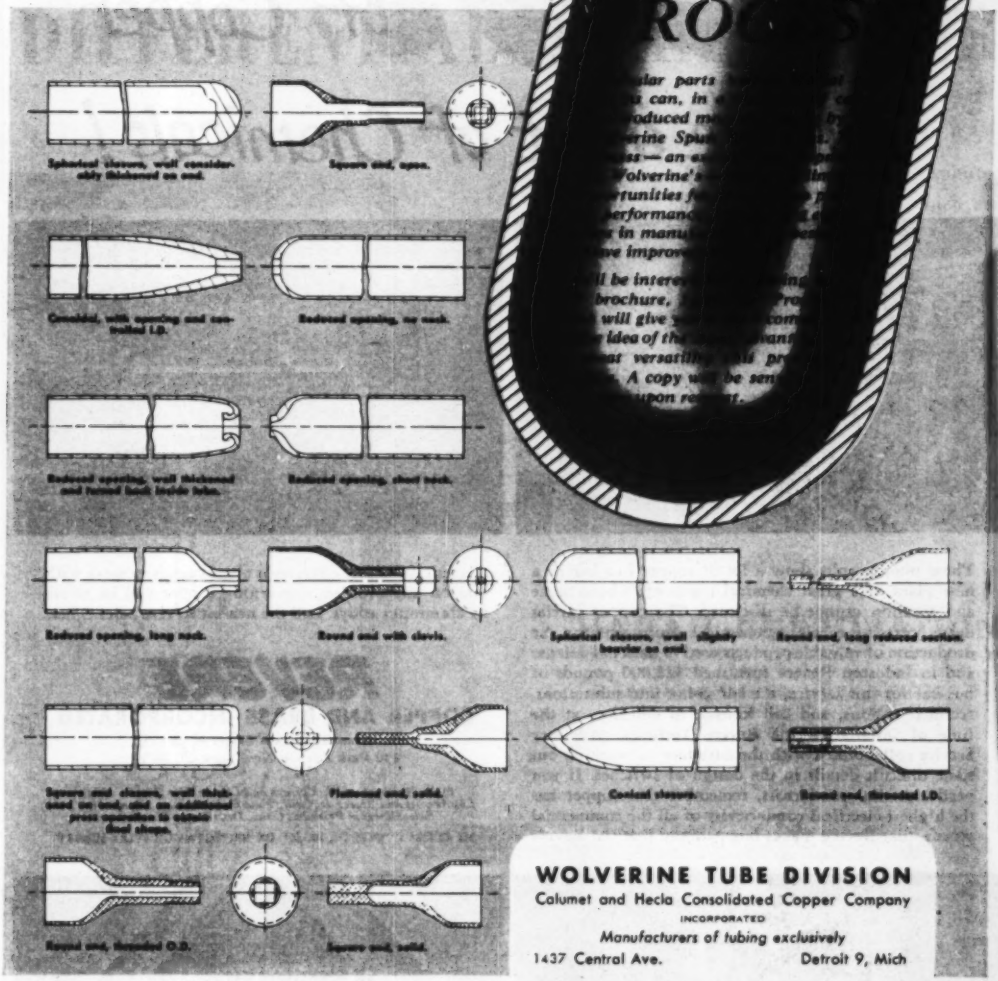
Chart read-back device gives easy access to past records without disturbing any function of the recorder or interrupting the record.

New chart drive mechanism for greater convenience and greater dependability.

Be sure to get information on the new and greater plug-in type Taylor TRANSET Control before you make any decision involving pneumatic transmission control. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Canada.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

A wide range of end shapes are offered by our


Spherical closure, wall considerably thickened on end.
Square end, open.
Consolidated, with opening and controlled I.D.
Reduced opening, no neck.
Reduced opening, wall thickened and turned back inside tube.
Reduced opening, short neck.
Reduced opening, long neck.
Round end with clevis.
Spherical closure, wall slightly heavier on end.
Round end, long reduced section.
Square end closure, wall thickened on end, and an additional press operation to obtain final shape.
Flattened end, solid.
Conical closure.
Round end, threaded I.D.
Round end, threaded O.D.
Square end, solid.

WOLVERINE TUBE DIVISION
Calumet and Hecla Consolidated Copper Company
INCORPORATED
Manufacturers of tubing exclusively
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Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario

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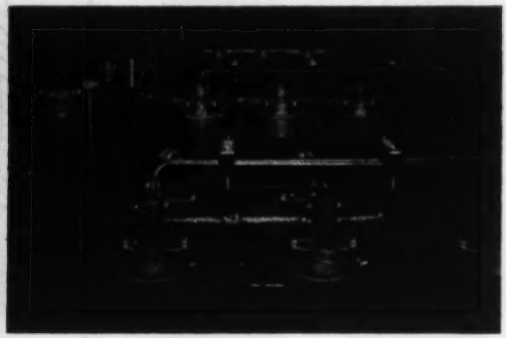
Sales Offices in Principal Cities

Export Department, 13 E. 40th St., New York 16, N. Y.

It takes a Lot of Copper to make a Lot of Chemicals!



These photographs show a lot of copper bus bar in a new plant of a great chemical company, whose name and location cannot be disclosed. The copper carries heavy currents to electro-chemical equipment for the production of valuable products used in national defense and in industry. Revere furnished 325,000 pounds of bus bar for this service, the bar going into substations, rectifier stations, and cell houses. In addition, at the time of installation the Revere Technical Advisory Service collaborated with the customer in working out some difficult details in the design of switches. If you need electrical conductors, remember that copper has the highest electrical conductivity of all the commercial metals, that Revere makes bus bar, and that the Revere Technical Advisory Service is always ready to work with you on any problem concerning copper and its alloys or aluminum alloys. Call the nearest Revere Sales Office.

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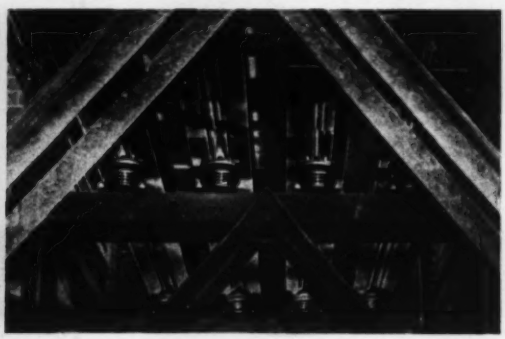

Announcing the new bulletin describing the HAGAN

DIFFERENTIAL TRANSMITTER

(TYPE FRB RING BALANCE)

The Hagan Type FRB Differential Transmitter produces pneumatic output signals which are linear with the pressure differential measured.

This transmitter can be used for generating output signal pressure under the wide range of differential and static pressure conditions, for both liquids and gases, common to the process industries, metallurgical furnace and steam plants.

Bulletin 3M-52 tells you about the Hagan Type FRB Differential Transmitter and what it does. It is yours for the asking.

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THRUSTOR FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

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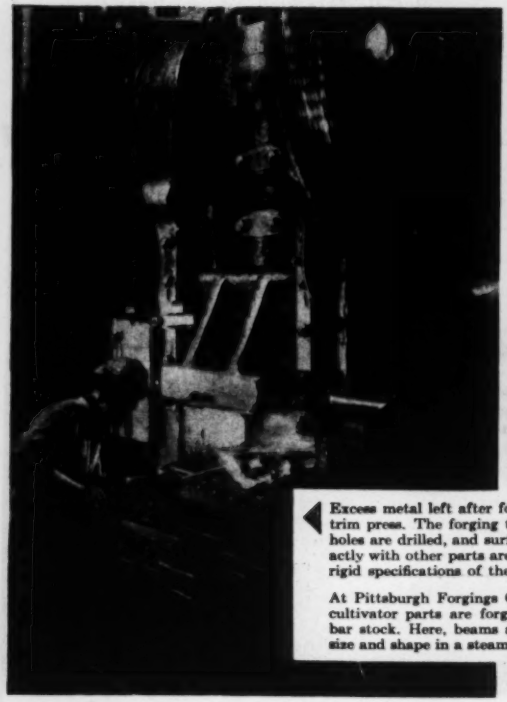
Mech-10

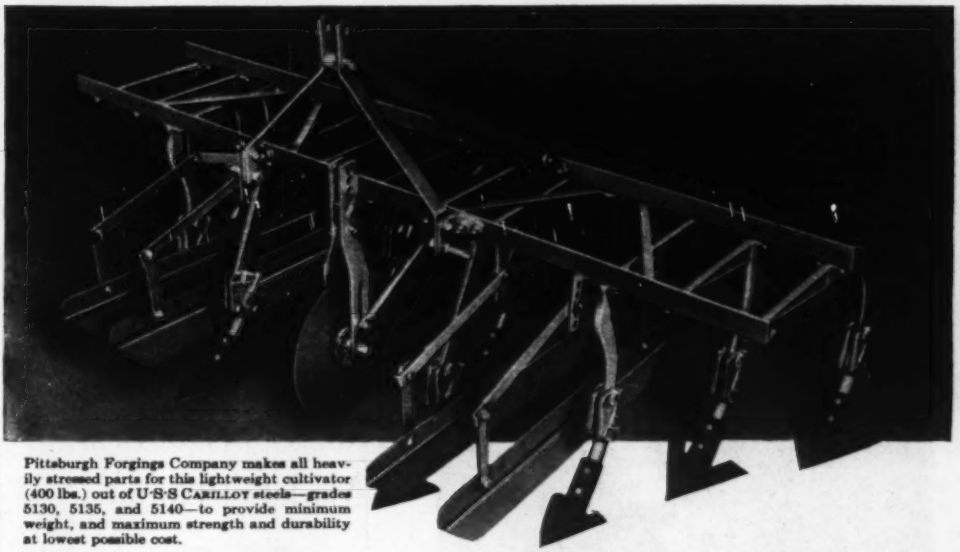
IN THIS HEAVY-DUTY CULTIVATOR

U·S·S CARILLOY steel effectively saves weight, increases durability,



Excess metal left after forging is removed in this trim press. The forging then is straightened, bolt holes are drilled, and surfaces that must align exactly with other parts are accurately milled to the rigid specifications of these cultivators.

At Pittsburgh Forgings Company precision-made cultivator parts are forged from CARILLOY steel bar stock. Here, beams are being forged to final size and shape in a steam hammer.



Pittsburgh Forgings Company makes all heavily stressed parts for this lightweight cultivator (400 lbs.) out of U·S·S CARILLOY steels—grades 5130, 5135, and 5140—to provide minimum weight, and maximum strength and durability at lowest possible cost.

and keeps costs down

TO pack the maximum strength into this heavy-duty lift-type cultivator and to keep its weight as low as possible, Pittsburgh Forgings Company of Coraopolis, Pa., has used U·S·S CARILLOY alloy steel in the shanks, beams, and main frame.

The excellent performance this equipment has been delivering is proof that many parts that must operate in extremely tough service can be made of alloy steels that do not contain critical elements. The three grades of U·S·S CARILLOY used here—CARILLOY 5130, 5135, and 5140—were selected by Pittsburgh Forgings Company years ago for the express purpose of providing minimum weight, maximum strength and durability at the lowest possible cost.

Strong and tough to permit speeds up to 6 miles per hour through heavy soil, CARILLOY steel construction has made it possible to reduce cultivator weight to only 400 lbs. This is about half that of comparable units made of ordinary carbon steel—well below the limit which the tractor lifting mechanism is designed to carry, light enough to be easily shifted on the ground by one man.

U·S·S CARILLOY alloy steel does more in this equipment than provide increased strength, greater durability, and added resistance to wear. It enables the manufacturer to safely decrease the size and weight of all heavily stressed parts, with the result that less steel is required and his costs can be kept well in line with competition.

Our metallurgists have had wide experience with similar applications in alloy steels and have developed special heat-treating procedures that make it possible to obtain maximum mechanical properties from them. We will be glad to assist you in selecting the steel and heat treating methods best suited to your product, and we believe we can help you. Just call the nearest District Sales Office, or write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

U·S·S Carilloy Steels

USS

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3-1439

UNITED STATES STEEL

M/Sgt. Hubert L. Lee, USA Medal of Honor

FOUR TIMES Sergeant Lee's platoon had taken, then lost, the hill near Ip-o-ri. On the fifth try, the sergeant, though hurt, was leading. A Red grenade hit him, seriously wounding both legs. Refusing assistance, he advanced by crawling, rising to his knees to fire. He caught a rifle bullet in the back. Still he wouldn't be stopped. Finally, with 12 survivors of his platoon, he took the hill, then let the stretcher-bearers carry him away. Today Sergeant Hubert Lee says:

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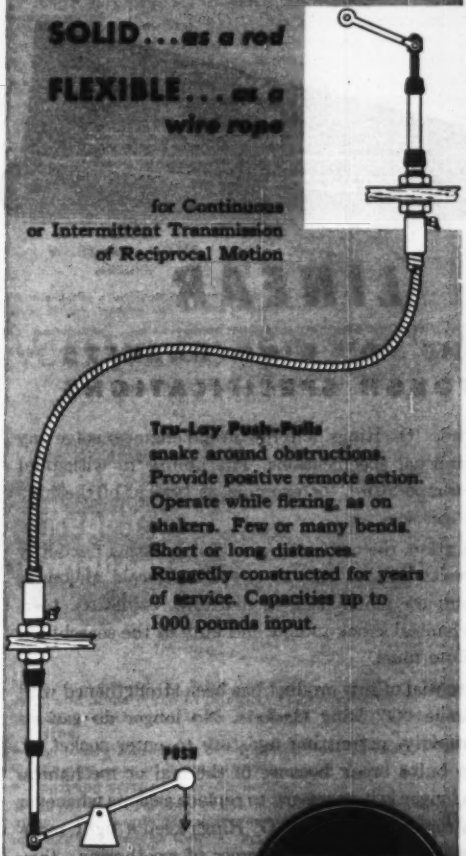

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MECHANICAL ENGINEERING
September, 1952 CARD INDEX Vol. 74, No. 9

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Copies of the List are obtainable from

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SILICONE "O" RINGS

Good News For Today's Designer

Results from a recent survey show the successful use of a variety of silicone compounds in seal applications never attempted before with a resilient material because of temperature limitations. According to Linear, Incorporated, of Philadelphia, Pa., a principal manufacturer of "O" Rings, one group of silicone compounds have been designed for general use at temperatures ranging from −65° to +500°F. Modifications of the general purpose stocks have produced several compounds with extreme low temperature flexibility. Other types possess a maximum resistance to compression set over a wide temperature range.

Chart Tells The Story

SILICONE RUBBER STOCKS

Linear Style No.	Hardness Shore A Scale	Tensile Strength Min. (P.S.I.)	Elongation Min. (%)	Temp. Range (°F.)	Compression Set*	Color
ZK-50	50	400	100	−65 to +400	10 to 20	Red
ZA-60	60	400	150	−65 to +400	50 to 70	White
ZM-70	70	500	75	−65 to +400	15 to 25	Gray
ZN-80	80	600	50	−65 to +400	20 to 35	White
ZT-60	60	350	130	−125 to +400	30 to 50	Red
ZD-60	60	350	150	−95 to +400	40 to 60	Red
ZG-45	45	550	250	−125 to +400	40 to 60	Red-Tan
ZJ-60	60	500	70	−65 to +400	20 to 30	Red
ZP-80	80	550	50	−70 to +400	60 to 80	Gray
ZS-80	80	550	50	−70 to +400	25 to 30	Gray
ZU-50	50	600	225	−65 to +400	65 to 75	Neutral

* Method B 22 hours at 300°F.

Notes:

1. *Temperature range values are based on actual experience in the field and the silicone rubber will perform very satisfactorily within these ranges over long periods of time. Intermittent temperatures as high as +500°F. are not harmful in most applications, but will shorten the ultimate life of the rubber.*
2. *All other values were determined at room temperature according to A.S.T.M. procedure. For silicones, room temperature values are retained with relatively little change over a wide temperature range. Therefore, they can be used with some assurance in selecting compounds for specific applications.*

Successful Usage Today

Silicone "O" Ring gaskets have proven to be highly successful as static sealing parts on a wide variety of equipment subject to extreme temperature conditions, oxidation, or to prolonged weathering. Silicone seals are giving outstanding service on certain types of aircraft shut-off valves which control the in-take of hot air from the intermediate stages of jet engine compressors under 500°F. operating conditions. Further investigation indicates the use of silicone "O" Rings on outdoor flood-lights, steam irons, transformers, geophysical equipment and diesel engines.

Research For Tomorrow

Linear Incorporated is continuing its Research Program to develop new silicone seals to meet the increasing demand for elastomers having a wide variety of physical properties. The future indicates that there will be expanding requirements for the many advantages offered by silicone as an outstanding engineering material for sealing purposes.

GASKET SPECIFICATIONS:

- MUST WITHSTAND TEMPERATURE VARIATIONS OF −125°F. to +400°F.
- MUST BE MOISTURE RESISTANT
- MUST WITHSTAND SEVERE THERMAL AND MECHANICAL SHOCK

LINEAR

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LINEAR Silicone "O" Rings help the design engineer solve any number of unusual specifications. The ability to withstand extremes in temperature, for example, is typical of the high flexibility of this seal.

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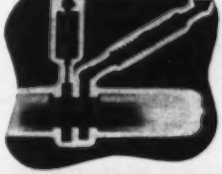

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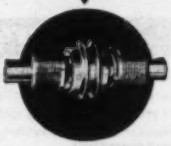

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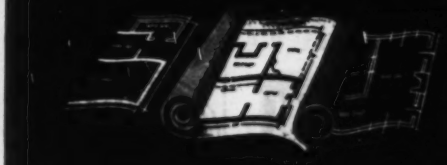

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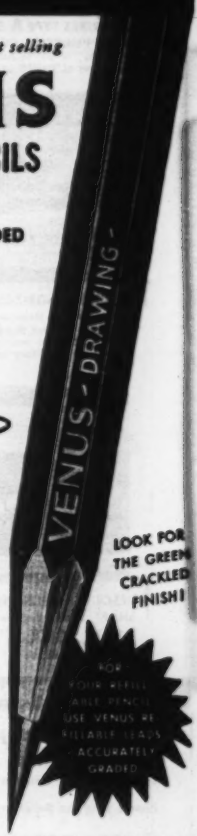

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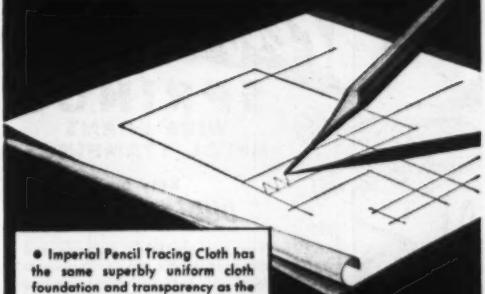

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Walter Tydon

*Walter Tydon, widely known aviation engineer and aircraft designer and veteran of 25 years in aviation, is Chief Engineer of Fairchild's Aircraft Division.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD *Aircraft Division*
HAGERSTOWN, MARYLAND

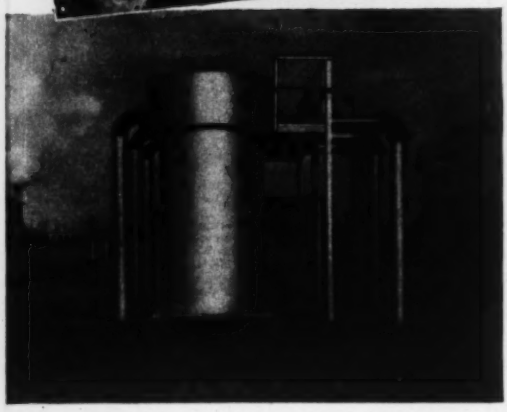
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

ENGINEERS AND PHYSICISTS BS-MS-PH.D.

Responsible positions in mechanical, electrical or electronic engineering, physics or engineering physics for advanced development and design of special equipment and instruments. Prefer men with minimum of two years' experience in experimental research design and development of equipment, instruments, intricate mechanisms, electronic apparatus, optical equipment, servomechanisms, control devices and allied subjects. Positions are of immediate and permanent importance to our operations. Southwestern location in medium sized community. Excellent employee benefits. Reply by letter giving age, experience and other qualifications. All applications carefully considered and kept strictly confidential. Ind. Rel. Manager, Research & Development Dept.,

PHILLIPS PETROLEUM COMPANY

Bartlesville, Oklahoma

Are You—

A mechanical engineering graduate?

More extrovert than introvert?

A self-starter?

Interested in personal independence and in wide variety of contacts and work?

Willing to trust your ability, industry, and personality to get you a worthwhile income in much less time than in other types of employment?

Then write, with our assurance that it will be treated in strict confidence, to Mann Engineering Company, 805 Bessemer Building, Pittsburgh 22, Pennsylvania, long established exclusive district sales representatives for two outstanding manufacturers of related mechanical equipment for industrial plants.

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

CENTRIFUGAL PUMP DESIGNER

To take charge of designing, developing and testing centrifugal pumps to 1500 horsepower. Must be experienced in single-stage design to 30,000 G.P.M. and multi-stage design to 1200 p.s.i. pressure. Furnish resume of qualifications.

Address CA-4004, % "Mechanical Engineering."

SWITCHGEAR DESIGN EXECUTIVE

Opportunity to establish and direct a switchgear design section including large air circuit breakers for leading electrical equipment manufacturer in Midwest. Must have had considerable experience in that specific field as well as both demonstrated design ingenuity and administrative ability. Unusual opportunity. Salary open. Give personal history, education, experience and compensation requirements. Will protect present employment. Address CA-4066, % "Mechanical Engineering."

ELECTRICAL EQUIPMENT DESIGNERS

Leading manufacturer of electrical distribution and motor control equipment is expanding permanent engineering staff. Wants electrical equipment designers—preferably but not necessarily with circuit breaker, safety switch, bus duct, panelboard, switchgear, or electric motor control experience. Midwestern location. Pension plan and liberal insurance program. Excellent opportunity for advancement. Salary open, give personal history, education, experience and compensation requirements. Will protect present employment. Address CA-4065, % "Mechanical Engineering."

TECHNICAL RESEARCH ENGINEER

Experienced man with mechanical and chemical engineering background. Should have strong bent for converting research results into workable industrial equipment; should also be able to carry out essential research in this connection. Versatility and energy are prime requisites. Initial effort will be in the field of high vacuum continuous coating.

Please send resumé to:

National Research Corporation
70 Memorial Drive
Cambridge 42, Massachusetts

PROJECT ENGINEER

National Engineering and Construction Company seeks an experienced Project Engineer with several years of petroleum engineering background for work in the Midwest.

This man must be capable of taking complete charge of a job, supervise layouts and design, select plant equipment, and maintain amiable customer relations.

In applying furnish a detailed resumé of your education, experience, references and a recent snapshot. Salary open. Address CA-4042, care of "Mechanical Engineering."

A BROAD APPROACH TO ATOMIC ENERGY DEVELOPMENT WITH GENERAL ELECTRIC

AT SCHENECTADY, NEW YORK

the Knolls Atomic Power Laboratory is developing a nuclear power plant for a submarine.

AT LOCKLAND, (Cincinnati) OHIO

the Aircraft Nuclear Propulsion Project of the Aircraft Gas Turbine Division is conducting a major development in the use of nuclear energy. Plans for testing at the National Reactor Testing Station, Idaho Falls, Idaho, are now under way.

AT RICHLAND, WASHINGTON

the Nucleonics Division conducts research, engineering design and process operations in the manufacture of nuclear fuels at the Hanford Plutonium Plant.

To engineers of strong technical and leadership capabilities, and with responsible experience, these major installations offer continuing opportunities. Under coordinated management, the present national defense objectives are providing the ground work for later peace-time applications, in close cooperation with the Company's research and power engineering groups.

Among the specific technical needs are:

- Scoping, chemical and mechanical engineering design of nuclear process plants.
- Fluid Mechanics and Heat Transfer Engineering.
- Instrumentation and Control, both electronic and thermal.
- Facilities Development and Test Engineering.
- Power Plant Installation.

You are invited to send your inquiry and resume to any of the following G-E organizations. All inquiries will be reviewed carefully on a confidential basis.

Employee Relations Section
Knolls Atomic Power Lab.
General Electric Company
Schenectady, New York

Supervisor of Personnel
Aircraft Nuclear Propulsion Project
General Electric Company
Post Office Box 132
Cincinnati 15, Ohio

Technical Personnel Services
Nucleonics Division
General Electric Company
Richland, Washington

Me...an AIRCRAFT Engineer? And live in California, too?

Yes, LOCKHEED CAN TRAIN YOU—AT FULL PAY!

A great new career can be yours—as an Aircraft Engineer at Lockheed, in Southern California.

The step up to Aircraft Engineering—and better living in California—isn't as steep as you might expect. Lockheed takes your knowledge of engineering principles, your experience in other engineering fields, your aptitude and adapts them to aircraft work.

ENGINEER TRAINING CENTER—An Engineer Training Center helps you convert to Aircraft Engineering quickly, easily, at full pay. Top engineers teach you "the language." You learn to work with closer tolerances, you become more weight-conscious. You may attend classes in the Training Center for three days—or six weeks. It depends on your experience and background. But, always, you receive full pay.

On-the-job training follows while you are on your regular assignment. It helps prepare you for promotion.

YOUR CAREER GOES UP—Lockheed's policy of developing its own executives gives you a head-start toward management posts. Under this program, Lockheed holds management-training classes on company time and Lockheed also helps you advance your education at major universities in the Los Angeles area. The result: 95% of all Lockheed management openings are filled by promotions from within the plant.

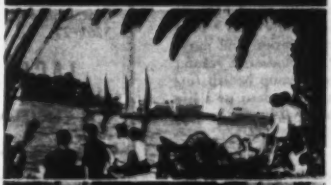
What's more, Lockheed has augmented top pay with a far-reaching system of employe benefits. An outstanding retirement plan, low cost insurance, social activities are only a few.

BETTER LIVING IN CALIFORNIA—Your way of life improves as well as your work when you join Lockheed. Living conditions are better in Southern California. The climate is beyond compare: cooling breezes day and night in the summer, sunshine in the winter. Golf, fishing, motoring, patio life at home are yours the year 'round. Beaches, mountains are only an hour from Lockheed. And your high Lockheed salary enables you to enjoy life to the full.

NOTE TO MEN WITH FAMILIES: Housing conditions are excellent in the Los Angeles area. More than 40,000 rental units are available. Thousands of homes for ownership have been built since World War II. Huge tracts are under construction near Lockheed.

Send today for illustrated brochure describing life and work at Lockheed in California. Handy coupon at right is for your convenience.

Special courses help you convert to Aircraft Engineering, prepare you for promotion.



Lockheed engineers enjoy swimming and boating at beaches such as Balboa and Laguna.

Patio life prevails the year 'round in Southern California.

ENGINEERING TRAINING PROGRAM
Mr. M. V. Mattson, Employment Mgr., Dept. ME-10

LOCKHEED
AIRCRAFT CORPORATION
Burbank, California

Dear Sir: Please send me your brochure describing life and work at Lockheed.

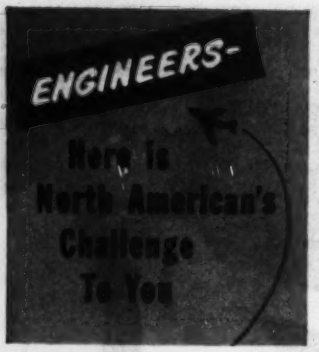
My Name _____

My Field of Engineering _____

My Street Address _____

My City and State _____

Nine Pages of "OPPORTUNITIES"



Frankly, working at North American requires hard thinking and plenty of vision. Because North American always works in the future. Yet, if you are interested in advanced thinking, if you'd like to work on the planes that will make tomorrow's aviation history, you'll like working at North American. North American offers these extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Educational refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

CHECK THESE OPPORTUNITIES AT North American

- Aerodynamicists
- Stress Engineers
- Aircraft Designers and Draftsmen
- Specialists in all fields of aircraft engineering
- Recent engineering graduates
- Engineers with skills adaptable to aircraft engineering

NORTH AMERICAN AVIATION, INC.

Dept. 6, Engineering Personnel Office
Los Angeles International Airport
Los Angeles 45, Calif.; Columbus 16, Ohio

North American Has Built More Airplanes Than Any Other Company In The World

---

INDUSTRIAL ENGINEER

Needed by large metal fabricator located in central Iowa to head up a section devoted to the development of standard data. Prefer college graduate. Must have three to five years' experience on indirect labor operations. Would prefer man with experience on machine shop, sheet metal and assembly operations. Please state qualifications in detail.

Address CA-4045, % "Mechanical Engineering."

THERMO-DYNAMIST

Mechanical Engineer with 2 years' or more experience in the field of thermodynamics and heat-transfer; would prefer a man with M.S. Degree, but not mandatory.

Unusual opportunity to make fast progress and gain recognition in an uncrowded industry, diversified work on a wide variety of projects. Company furnished meals, coffee, insurance, hospitalization and medical care. Liberal vacation policy. Plant location Cleveland suburb, close to good residential areas. Outline experience and minimum salary requirements in letter. Write Dept. 3261-27.

JACK & HEINTZ

CLEVELAND 1, OHIO

STOKER SALES ENGINEER

Old and well established manufacturer of industrial stokers has an opening for a Sales Engineer with a background in steam generation.

Technical graduate preferred but not essential if sufficient practical experience in combustion work has been secured. The line of stokers includes both Heating and Power Plant types.

Replies, giving age and experience, will be held in strictest confidence.

Address CA-4059, % "Mechanical Engineering."

Use a CLASSIFIED ADVERTISEMENT *for Quick Results*

MECHANICAL ENGINEER

Prefer a man with general mechanical design and development experience on a-c and d-c rotating electrical machines, but not mandatory. Background on aircraft equipment not necessary, but desirable.

Unusual opportunity to make fast progress and gain recognition in an uncrowded industry, diversified work on a wide variety of projects. Company furnished meals, insurance, hospitalization and medical care. Liberal vacation policy. Plant location Cleveland suburb, close to good residential areas. Outline experience and minimum salary requirements in letter. Write Dept. 3261-27.

JACK & HEINTZ, INC.

CLEVELAND 1, OHIO

AC SPARK PLUG DIVISION OF GENERAL MOTORS CORPORATION

PRECISION INSTRUMENT PLANT

Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

MECHANICAL DESIGN ENGINEERS
ELECTRONIC ENGINEERS
SERVO ENGINEERS
ELECTRONIC DESIGNERS
MECHANICAL DESIGNERS

New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

Write or Apply

AC Spark Plug Division
General Motors Corporation
1925 E. Kenilworth Place
Milwaukee 2, Wisconsin

Nine Pages of "OPPORTUNITIES"

MECHANICAL ENGINEER

Responsible permanent position in new section of established company.

Graduate, age 35-50, experienced in chemical industry design including pressure vessels, piping, materials and specifications.

Paid holidays, paid vacation, low cost group health, accident and life insurance, retirement plan.

Salary commensurate with ability and experience.

Submit resumé of personal history, education, experience, salary expected.

Application confidential.

DIRECTOR OF DEVELOPMENT
NITROGEN DIVISION
ALLIED CHEMICAL & DYE CORP.
ORGANIC DEPARTMENT
HOPEWELL, VIRGINIA

The Tennessee Valley Authority wants Mechanical Engineers to assist in the design, construction, and operation of large steam electric and hydroelectric projects and transmission systems. Salaries start at $3700, $4450, and $5325 for 40-hour week. All jobs carry automatic within-grade increases for satisfactory service, liberal vacation leave, sick leave, and retirement benefits. Design jobs are in Knoxville and Chattanooga, Tennessee. Field construction and operations jobs are at various sites in the Tennessee Valley area and at Paducah, Kentucky. Write the

TENNESSEE VALLEY AUTHORITY

Division of Personnel
Knoxville, Tennessee

TECHNICAL PERSONNEL

looking for
INCREASED RESPONSIBILITY
in

ENGINEERING
- PRODUCTION
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- INSTRUMENTATION
- CONSTRUCTION LIAISON
- INDUSTRIAL ENGINEERING
- DESIGN AND DEVELOPMENT
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investigate opportunities at our

ATOMIC ENERGY INSTALLATIONS

Send resume and request for detailed information concerning Openings, Company Policies and Community Life

TECHNICAL PERSONNEL OFFICE
CARBIDE AND CARBON CHEMICALS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
POST OFFICE BOX P, OAK RIDGE, TENN.

READ the CLASSIFIED ADVERTISEMNTS
appearing in this section each month.

Aerophysicists, Designers, Engineers

YOUR IDEAS WILL COUNT AT NORTH AMERICAN

North American encourages advanced thinking, because they know looking ahead is the only way to maintain leadership in the aviation industry. That's why North American needs men of vision. If you like hard thinking and would like to work for a company that will make the most of your ideas, you'll find real career opportunities at North American. North American offers you many extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Education refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

IS YOUR FIELD LISTED HERE ?

Airborne Electronic Equipment
Equipment Flight Tests
Precision Instruments
Automatic Controls
Propulsion Systems
Servo-Mechanisms
Airframe Studies
Radar Devices
Instrumentation
Micro Wave Techniques
Metallurgical
Electroplating
Engineering Planning

NORTH AMERICAN AVIATION, INC.

Aerophysics, Electro-Mechanical Research Division

Dept. 6, Personnel Section,
12214 Lakewood Blvd., Downey, California

North American Has Built More Airplanes Than Any Other Company In The World

ENGINEERS

LOCATE IN THE

Healthful Southwest

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, and Mathematicians. A variety of positions in research, development and production open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

Land of Enchantment

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment," Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

Make application to the

PROFESSIONAL EMPLOYMENT DIVISION

SANDIA *Corporation*

SANDIA BASE

ALBUQUERQUE, N. M.

TECHNICAL WRITERS & SPECIFICATION ENGINEERS ALSO NEEDED

INSTRUMENT ENGINEER

Engineering Design pertaining to instruments. Field work on instrument problems and development. Experience or special training preferred. Modern expanding chemical plant in Ohio Valley, West Virginia panhandle. Congenial management, excellent future possibilities.

Address CA-4063, % "Mechanical Engineering."

Excellent Opportunity

Engineers
Chemical, Mechanical, Electrical
for
Sales
Estimating
Design
Process Development

Fast Growing
Medium Size Company
Major Chemical Process Equipment

Air Products, Inc.
P O Box 538
Allentown, Penna.

MECHANICAL ENGINEER

Experienced or interested in

MACHINE DESIGN

Permanent position for graduate, age 28–50. Previous experience in excavator design desirable but not a must.

Company is small but progressive and is presently expanding production facilities. Sales volume $8,000,000 per year, Dunn and Bradstreet AA1, approximately 800 employees including steel foundry. Population of Marion, Ohio, about 37,000. Product—excavators 1/2 yard to 2-1/2 yard.

Applicant must be board designer well grounded in engineering mechanics and machinery layout. Salary open. Write or apply giving complete qualifications and references. Your reply will be held confidential.

THE OSGOOD COMPANY
CHENEY AVENUE
MARION, OHIO
ATTN: J. E. Calloselle, Chief Engr.

Additional Opportunities are offered in the display advertisements—

on pages

64, 65, 111, 114, 139

DUPONT

Offers MECHANICAL ENGINEERS

Responsible Field Engineering Positions on

The Savannah River Project

- a Billion Dollar Atomic Materials Plant for the U. S. Atomic Energy Commission.

Minimum qualifications for the openings are a B.S. Degree and considerable PROCESS PIPING INSTALLATION EXPERIENCE.

To well qualified engineers who are interested, we invite your consideration of the following advantages—

★ Association With an Outstanding Engineering Group

★ Opportunity to Add a Great Experience to Your Professional Career

★ 54 Hr-Week With Overtime Pay

★ Housing Assistance & Excellent Employee Industrial Relations Plan

FOR FURTHER INFORMATION

Kindly Wire, Telephone or Send Us Your Name and Address

E. I. du Pont de Nemours & Co., Inc.

Construction Recruitment Section

P. O. Box 117 Augusta, Ga.

POSITIONS OPEN

PROFESSIONAL ENGINEER—with 10 years' experience in the operation and maintenance of central steam heating plant generating at 125 lbs. Plant at present undergoing extensive maintenance to effect more efficient firing. Must be capable to directing unskilled personnel in the accomplishing of repairs, etc. Plant located in Northeastern New Mexico at elevation of approx. 6300 ft. in city of approx. 10,000, atmosphere very dry, climate moderate. Address inquiries to: Board of Directors, New Mexico State Hospital, Las Vegas, New Mexico, giving full experience record, two references and salary expected.

Excellent Opportunity for MECHANICAL AND LUBRICATION ENGINEER—One who is thoroughly familiar with Ball and Roller Bearings. A college graduate in Mechanical Engineering preferred. At least five years' actual experience in general industry. Willing to travel. Write giving full details and qualifications in first letter. Salary Open. Address CA-4002, care of "Mechanical Engineering."

PRODUCT DEVELOPMENT PROJECT ENGINEER—Graduate engineer with several years' experience in field of paper, coated paper or similar fabricated products as a research engineer, product development engineer, machinery designer, methods engineer or in other engineering capacities. Position requires conducting research into materials, methods and machinery—offers excellent opportunity for creative work and advancement. Superior working conditions including medical and surgical plans, hospitalization plan, annuity plan and life insurance coverage equal to salary. Congenial co-workers. Eastern location. Available to metropolitan area. Salary $4,500 to $6,500, junior engineer; $6,000 to $8,000, senior engineer. Address CA-4033, care of "Mechanical Engineering."

DEVELOPMENT ENGINEER—with creative ability and originality to head design group and experimental laboratory for development of new, high-speed automatic equipment, and improvements to existing machinery, for manufacture of matches, woodenware and paper products. Thorough knowledge of modern machine design practice and utilization of present-day engineering materials required. Mechanical Engineering Graduate with technical training and experience preferred. Age 40-50 years. Permanent position, some travel. Salary open. Submit resumé. The Diamond Match Company, Engineering & Mechanical Development Department, P. O. Box 229, Barberton, Ohio.

DESIGNER—Experienced in design of special small and medium size machines, intricate mechanisms and tools. Positions in research department on experimental and prototype equipment. Must have record of accomplished designs made on his own. Superior working conditions including medical and surgical plans, hospitalization, plan, annuity plan and life insurance coverage equal to salary. Congenial co-workers. Eastern location. Available to metropolitan area. Salary $6,000 to $8,000. Address CA-4034, care of "Mechanical Engineering."

ENGINEER—SYNCHRO MECHANISMS—Engineer, with extensive background in design and manufacture of synchro transformers, resolvers and repeaters on full time or consulting basis with well established firm having excellent reputation in another field. Location, Metropolitan New York area. State qualifications. Address CA-4037, care of "Mechanical Engineering."

EDITOR—or Literature Scientist, to handle technical literature in foreign languages including French, German, Italian, Russian, etc. Salary commensurate with experience and ability. Permanent position with established organization. Desirable personnel benefits. For further information or interview, reply giving age, complete resumé of education, experience, other pertinent data. Address CA-4039, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Qualifications: Mechanical engineer with at least five years' experience in designing chemical process type equipment, with broad background in selection of materials of construction and analysis of stresses in protection and design of pressurized equipment and in fabrication methods and techniques. Experience in maintaining equipment of this type will be beneficial. Should be capable of assuming responsibility for establishing mechanical design practices in the Engineering Division of a large food and chemical processing company and for supervising the work of other engineers needed to carry out such a program. Age: Preferred age range 30 to 40. Salary: Open. Location: Midwest. Requirements: Provide information on experience, education and age in reply. Address CA-4043, care of "Mechanical Engineering."

SALES ENGINEER—Experienced in the sale of boiler feedwater conditioning. Must be familiar with Philadelphia area. Salary open, well established firm. Please send resumé of background. All replies held confidential. Address CA 4061, care of "Mechanical Engineering."

SALES ENGINEERS—for large industrial instrument manufacturer. Prefer men with special training in electronics and graduates of recognized engineering colleges. Will consider Mechanical and Chemical Engineers. Fine opportunity for young engineers with sales aptitude to connect with one of the fastest growing industrial instrument companies in the United States. Locations: Cleveland, New York, Chicago, and Philadelphia. Address CA-4062, care of "Mechanical Engineering."

See Advertisements on preceding pages

DRAFTSMEN...

WHY IT WILL PAY YOU TO WORK ON NUCLEAR POWERED SHIPS

with Electric Boat, in Groton, Connecticut

1. **OPPORTUNITY**—Pioneer in this great new field of today ... get a head start on the unlimited potentialities it provides for tomorrow ... with Electric Boat, designers and builders of the world's first atomic-powered submarines!
2. **STABILITY**—No draftsman has been laid off at Electric Boat in 20 years!
3. **HIGH WAGES**—Together with achievement and security, your high earnings plus overtime provide a strong basis for satisfaction.
4. **RELAXATION**—Leisurely living in Groton, Connecticut, free from city pressures, within minutes of every recreational facility. Electric Boat's Housing Bureau will help you relocate.

ELECTRIC BOAT

division of General Dynamics Corp.

GROTON CONNECTICUT

... with following experience:

ELECTRICAL, experience on marine or electronic circuits

MECHANICAL, knowledge of materials and mechanical processes

STRUCTURAL, knowledge of shipbuilding

PIPING, marine experience, or steam power plant, oil refinery or heavy chemical plant experience.

Clip This Handy Coupon Now! Application sent to you immediately.

Peter Carpenter
Electric Boat Division, General Dynamics Corp.
Groton, Conn.

Please send me an application form for one of the profitable positions now open at Electric Boat.

Name .....

Address .....

City ..... State .....

POSITIONS WANTED

INDUSTRIAL RESEARCH ENGINEER

desires executive level position in metropolitan New York or Chicago. 15 years' experience in industrial research laboratory operation and management. M.I.T. Mechanical Eng. graduate plus advanced degrees. Currently employed at salary of $15,000. Address CA-4055, care of "Mechanical Engineering."

SALES ENGINEER—BSME, '38 with excellent connections and 14 years' experience desires good nationally advertised lines for Mexico. Exclusive basis only and as manufacturer's representative. M. J. Schroeder, Matamoros, 1236 Pte., Monterrey, Mexico.

MECHANICAL ENGINEER—29—B.S. Degree. 6 years' plant engineering experience in paper mill. Desires position as plant engineer. Salary requirement $10,000. Available January 1st. Address CA-4030, care of "Mechanical Engineering."

ENGINEERING EXECUTIVE—40, advanced degrees, desires executive position. Unusual scientific background; manufacturing experience; management background including Director of Research, Chief Engineer, with some sales. Outstanding accomplishments in power plants, aircraft, rotating machinery, refrigeration and air conditioning. Address CA-4032, care of "Mechanical Engineering."

MECHANICAL ENGINEER—34, BSME, M.E., Registered. 12 years of diversified experience in plant engineering involving heating and ventilation, machine design, structural and piping. Now occupied as project engineer supervising the design and installation of heavy and light machinery for processing plant. Desires responsible position as plant engineer or assistant. Address CA-4035, care of "Mechanical Engineering."

HEAT TRANSFER SPECIALIST—Ph.D., chemical engineer, math minor, seven years' diversified industrial experience, two years consulting and teaching experience, active AEC and Air Force clearances, publications, Sigma Xi. Address CA-4038, care of "Mechanical Engineering."

REGISTERED MECHANICAL ENGINEER—Graduate Master in M.E.—31—Seeking better position as Mechanical Engineer, Salesman or Firm Representative here or in Cuba. Experience in oil refinery. Speaks English and Spanish. Presently employed in the South. Address CA-4040, care of "Mechanical Engineering."

CHIEF ENGINEER—BME, registered, 11 years' experience. Excellent background in all phases of product development and engineering. Handled pneumatic, hydraulic and electro-mechanical projects. Good electrical and industrial electronics experience. Presently employed as Chief Engineer, previous experience as manager of research and development department. Desire responsible position at administrative level. Address CA-4041, care of "Mechanical Engineering."

SENIOR ENGINEER—B.S., M.S., has had 12 years of all around experience in instrumentation, servo's, instrument design, electronics and production. Had supervisory and organizational experience in large operation. Eastern location preferred. Address CA-4046, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Member of ASME. Age 49, married; Registered Graduate Engineer; Now employed, desires position as Mechanical Engineer. Twenty years of diversified mechanical experience involving Tool and Machine Design, Testing, Patent Developments, Pipe Fabrication, Inspection, and Administrative Duties. Will travel if necessary. Address CA-4047, care of "Mechanical Engineering."

MECHANICAL ENGINEER—25 years' experience in design, construction and operation of building mechanical systems and boiler plants. Responsible charge of major private industrial and governmental projects. Graduate Illinois Tech, Registered, Member ASME. Desire connection with engineering consultants or industrial plant administrative engineers. Excellent record, one employer over 15 years', located mid-west. Address CA-4052, care of "Mechanical Engineering."

MECHANICAL ENGINEER—31, married, MS, Chief Engineer presently employed with small company developing electronic and electro-mechanical devices. Broad background including sales and negotiations for government contracts. Desires similar responsible position. Address CA-4057, care of "Mechanical Engineering."

It will pay you to watch the announcements on these pages for an opportunity that you may be looking for or one that may be of interest to you.

INVENTIONS

WRITE for information about service for selling inventions. Patent Engineering Development Co., 624 Southern Standard Building, Houston, Texas.

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

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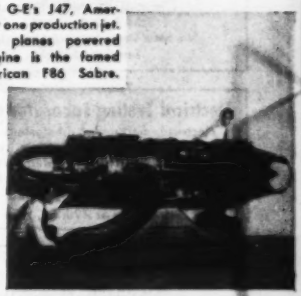
Boeing B-47, shown in rocket-assisted take-off. Powered by six G-E engines, the B-47 is the fastest known bomber in the world.



Cutaway of G-E's J47, America's number one production jet. Among the planes powered by this engine is the famed North American F86 Sabre.

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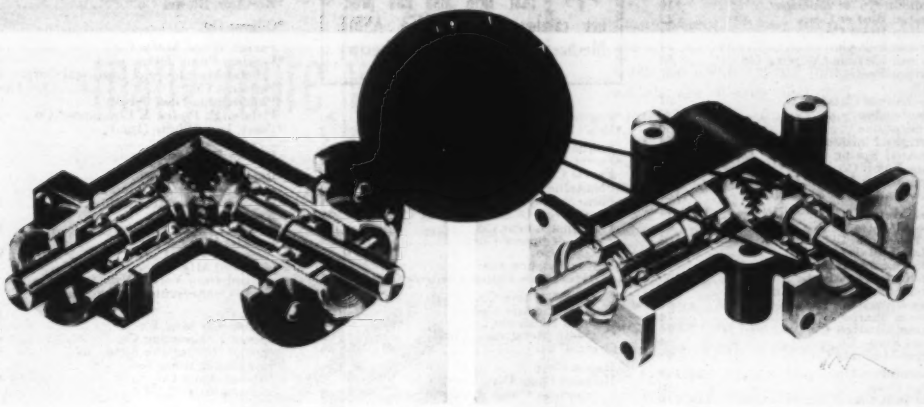

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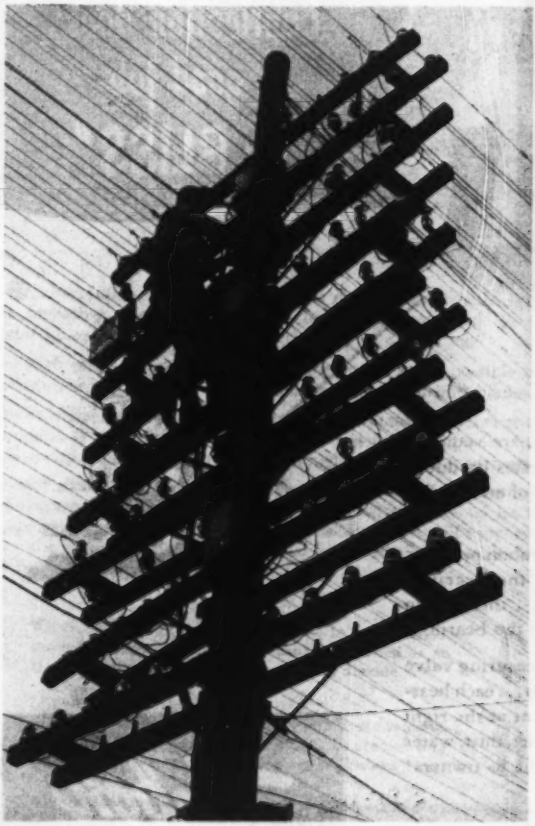

MUCH of your Long Distance telephone system works through cable but open-wire lines are still the most economical in many places. Thousands of these circuits are so short that little would be saved by using elaborate carrier telephone systems which are better suited for long-haul routes. But a new carrier system . . . the Type O designed especially for short hauls . . . is changing the picture. It is economical on lines as short as 15 miles. With Type O thousands of lines will carry as many as 16 conversations apiece.

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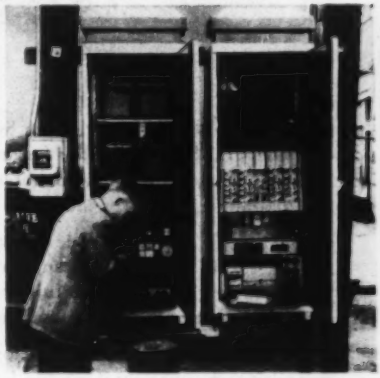
Moreover, the new carrier system saves copper by multiplying the usefulness of existing lines. For telephone users it means more service . . . while the cost stays low.



Repeater equipment is mounted at base of pole in cabinet at right, in easy-to-service position. Left-hand cabinet houses emergency power supply. System employs twin-channel technique, transmitting two channels on a single carrier by using upper and lower sidebands. A single oscillator serves two channels.

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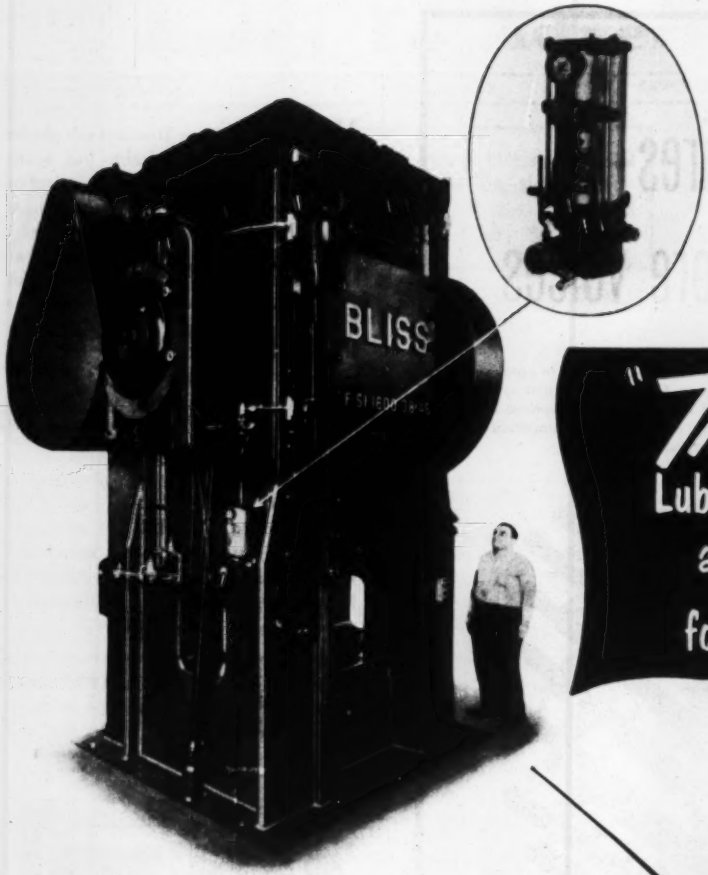
Improving telephone service for America provides careers for creative men in scientific and technical fields



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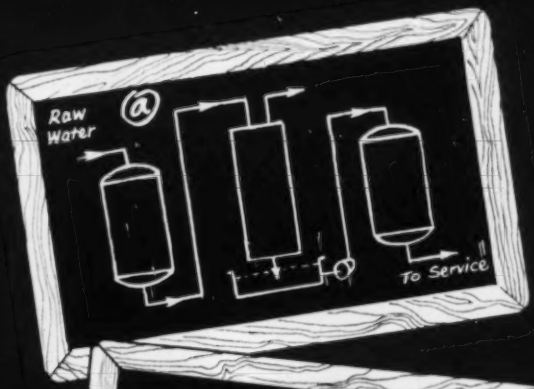
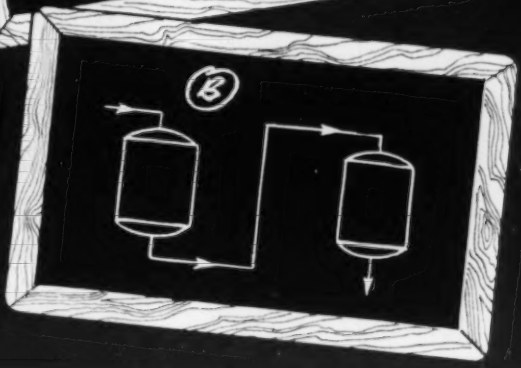
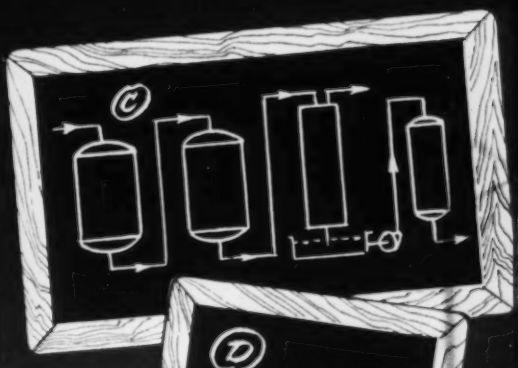
The ABC's of Better Boiler Feedwater







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For high pressure power plants that means it is now possible to avoid boiler scale and hard-to-remove silica deposits on turbine blades.

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Several arrangements of equipment are used depending on the individual requirements—composition of the raw water, volumes to be treated, boiler pressures and operating conditions. Permutit will cooperate with you in selecting the hookup best suited for your boiler plant. Write today for full information.

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D **MIXED BED:** An extremely compact arrangement. Both cation and anion exchangers are in the same unit. Used alone or as a final step.

The equipment described is also furnished in multiunit arrangements to treat whatever quantities of water are required and to meet all operating conditions.

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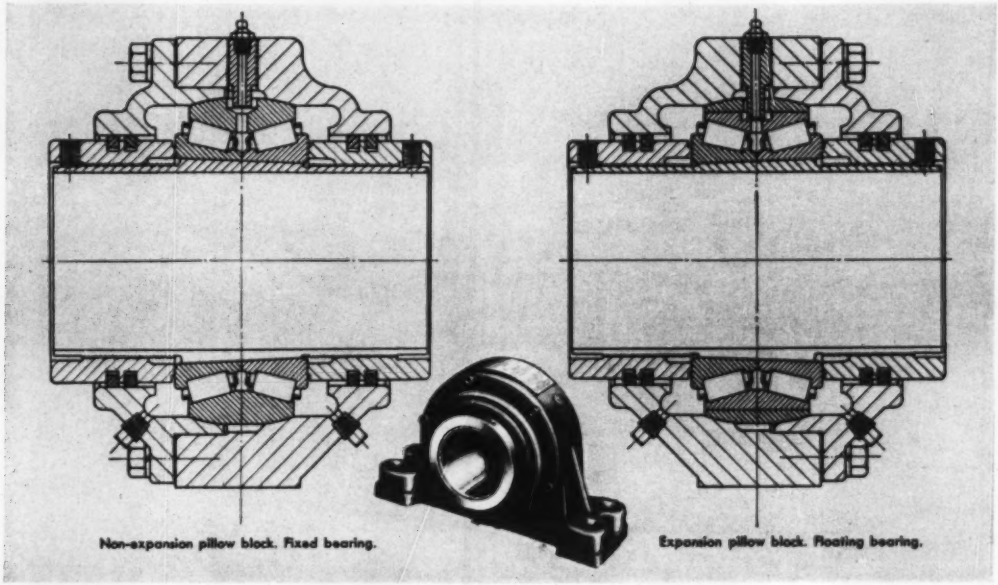

First application of new tapered bore TIMKEN® bearing makes new Dodge-Timken pillow block more compact

IT takes up less space. It weighs less. Yet the new Dodge-Timken® All-Steel pillow block has tremendous load-carrying capacity.

It's the result of the combined achievements of the Dodge Manufacturing Corporation, Mishawaka, Indiana, and The Timken Roller Bearing Company and makes use of an entirely new Timken bearing. Never before has a self-aligning, non-adjustable tapered roller bearing with tapered bore been used in pillow blocks.

Being of all-steel construction, this new Dodge-Timken pillow block is more compact and fills a real need where space is a factor. It is available in both expansion and non-expansion designs. And it incorporates all the advantages of Timken tapered roller bearings.

Because of their tapered construction, Timken bearings take radial and thrust loads in any combination. Line contact between rollers and races gives Timken bearings load-carrying capacity to spare. Timken bearings are made of the finest steel ever developed for tapered roller bearings—Timken fine alloy steel—and under normal conditions will last the life of the machinery with which the pillow blocks are used.

When you install new Dodge-Timken pillow blocks, you can expect dependable performance because the bearings are the best. No other bearing can give you all the advantages you get with Timken bearings. Specify them for all your other machinery, too. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL ⇕ AND THRUST →⇕← LOADS OR ANY COMBINATION ✳